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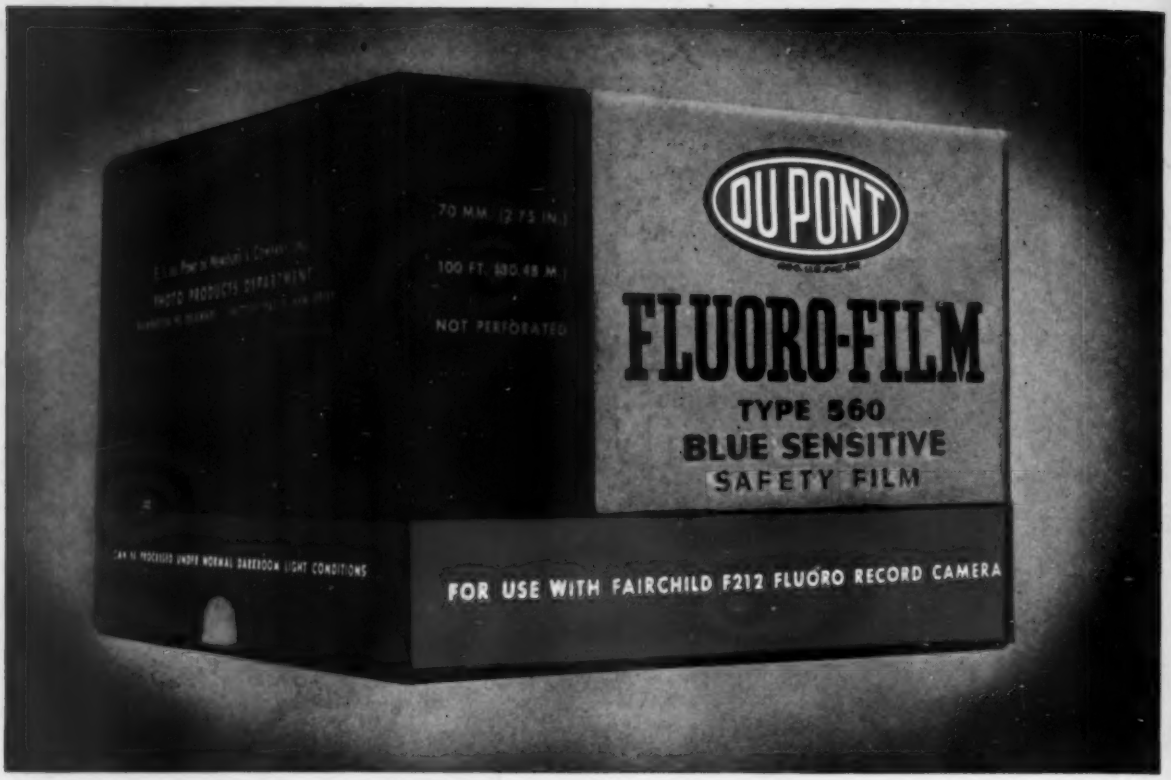

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FREDERICK W. O'BRIEN

Janeway Lecturer, 1946

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. 57 MARCH, 1947 NO. 3

THE RADIUM TREATMENT OF CANCER OF THE CERVIX

A HISTORICAL REVIEW

JANEWAY MEMORIAL LECTURE*

By FREDERICK W. O'BRIEN, M.D.
BOSTON, MASSACHUSETTS

CANCER of the cervix as differentiated from cancer of the corpus was not recognized until the middle of the XIXth Century with the birth of cellular and microscopical pathology.

Amputation or cauterization of the cervix, vaginal or abdominal hysterectomy were the accepted procedures advocated for its eradication. Because of better provision for drainage and less likelihood of peritoneal contamination operations by the vaginal route were favored until late in the XIXth century. With the introduction of methods of antiseptic and aseptic surgery, abdominal procedures became well established and increasingly favored.

J. G. Clark,[13] while resident gynecologist at Johns Hopkins in 1895, devised an operation to include removal of the lymph nodes before Wertheim popularized the operation which bears his name. Clark was the first to advise preliminary catheterization of the ureters and drainage of the pelvis through the vagina. E. Reis of Chicago also independently conceived and executed the same procedure. Wertheim's operation, described in 1898, is less limited in extent that either of these and was finally adopted as adequate.

Pierre Curie announced the discovery of radium in 1898; a discovery in its day heralding an approach in the treatment of cancer as revolutionary as in our day is the approach to peace or chaos of its direct offspring, atomic energy.

The therapeutic application of radium to exposed surfaces of the body began almost at once. The discovery of the action of radium on human tissue was accidental, says Schmitz,[70] in describing the renowned "radium burn" of Henry Becquerel. In 1901, Becquerel was experimenting with a tube of radium. He put the tube in his vest pocket where it remained for several hours. Some fourteen days later the adjacent skin showed a virulent inflammation. Pierre Curie immediately drew the conclusion that radium might possess properties of medical value. He then gave radium for experimental purposes to Danlos, a physician in St. Louis Hospital, Paris.

* The Eleventh Janeway Memorial Lecture, delivered at the Twenty-eighth Annual Meeting of the American Radium Society, San Francisco, Calif., June 28–29, 1946.

The first suggestion that radium be used interstitially within deep-seated cancer came curiously enough from Alexander Graham Bell, inventor of the telephone. In a letter to Dr. Z. T. Zowers,[83] published in 1903, Bell wrote as follows:

Dear Dr. Zowers:

I understand from you that the roentgen rays and the rays emitted by radium have been found to have a marked curative effect upon external cancers, but that the effects upon deep seated cancers have not thus far proved satisfactory.

It has occurred to me that one reason for the unsatisfactory nature of these latter experiments arises from the fact that the rays have been applied externally, thus having to pass through healthy tissues of various depths in order to reach the cancerous matter.

The Crookes' tube from which the roentgen rays are emitted is, of course, too bulky to be admitted into the middle of a massive cancer, but there is no reason why a tiny fragment of radium sealed up in a fine glass tube should not be inserted into the very heart of a cancer, thus acting directly upon the diseased material. Would it not be worth while making experiments along this line?

(Signed) Alexander Graham Bell

The first authenticated use of radium in the treatment of cancer of the cervix that I have been able to find is that by Dr. Margaret Cleaves[16] of New York. At a meeting in Atlantic City in September, 1903, she stated, "On September 15 through the courtesy of both Prof. Charles Baskerville, Director of the Laboratory, Department of Chemistry, University of North Carolina, and Eimer and Amend of New York, the writer was enabled to use one gram of bromide of radium contained in a sealed glass tube and having an activity of 7,000 in the treatment of two cases." One was a case of sarcoma of the cheek, the other an inoperable primary pelvic case of epithelioma involving the cervix, anterior and posterior vaginal walls almost to the introitus. This case had been under treatment for three months by means of roentgen rays (intravaginal applications entirely) and ultraviolet light, with marked regression of the lesions. The cervix uteri and adjacent vagina remained intensely congested, just ready to bleed. Into the water jacket of a vaginal roentgen tube closed at its distal end, the tube of radium bromide was placed and allowed to lie on the posterior surface of the tube for five minutes and then held for five minutes more near the anterior surface of the tube because of the vesical involvement.

The following day the cervix uteri was found to be completely blanched. Another application of the same length was made. This, she believed, was a mistake since on examination, forty-eight hours later, intense congestion and bleeding were present. Three days later, however, there was no bleeding and the vaginal and cervical mucous membrane were normal in appearance.

An original article by William James Morton, M.D.,[52] appeared in October, 1903, in which he described a radium applicator "to be introduced within cavities where it has been impossible heretofore to practically introduce the X-ray. This particularly applies to cancer of the throat treated from within and cancer of the uterus treated within the vaginal cavity." His device consisted of a celluloid or glass test tube in which the radium capsule was supported by a rod passed through corks, one of these closing the mouth of the tube and supporting the rod rigidly. "In cancer of the uterus as well as within the throat cavities, the radium salt thus proves to be a great blessing," he wrote. He gave no instance, however, of its clinical application.

Truman Abbe,[3] on November 11, 1903, addressed the Medical Society of the District of Columbia on his experience with the therapeutic action of radium in which he said, "My own experience is limited to a single case of inoperable carcinoma of the cervix and vagina, that I have been treating in association with Dr. G. Brown Miller. We had at our disposal a specimen of German radium with an activity of possibly 1,500 loaned from the Smithsonian collection. We can say that the radium thus far certainly has some good effect, for the patient has been relieved in a great measure of her pain for which she previ-

ously had to take morphine several times a day. Moreover, what discharge she had seems to have ceased and the surface of the mass is apparently smoother than before the radium treatment was begun. The final outcome is dubious. However, we feel that the radium has at least distinctly ameliorated the symptoms of the cancer and made life more bearable."

Dieffenbach,[18] of the Flower Hospital, New York, as delegate to the First International Congress for the Study of Radiology and Ionization, at Liege in September, 1905, reported two cases of inoperable recurrent carcinoma of the cervix treated with radium salts with improvement in one case. He refers to the work of the chemist, Hugo Lieber, who had succeeded in dissolving radium salts in such a manner as to form a film or coating on suitable appliances and thus secure all rays and emanations given off without immediate loss of substance. He found celluloid in the shape of rods and plates most suitable for coating and at Diffenbach's suggestion coated bougies for vaginal and rectal applicators.

These case reports antedate that of Robert Abbe,[1] of New York, usually credited with having been the first to treat cancer of the cervix with radium. In reply to a question at a meeting of the Practitioners Society of New York, December 1, 1905, Dr. Abbe said he had given radium treatment a trial in two or three cases of cancer of the cervix uteri. In one case which was pronounced an epithelioma by Dr. F. C. Wood, the radium tube was inserted into the cervix on two occasions and left there for twelve hours. The cervix became swollen and firm. The patient when seen several months later was without evidence of malignant disease. In another case where the disease of the cervix was so extensive that an amputation or other operation seemed useless, he curetted away all diseased tissue until firm, tough uterine structure remained and, on the following day, placed three of his strongest radium specimens in place for twenty-four hours.

In 1913 Abbe[2] stated, "My earliest case occurred in 1905 and, after curettage, was radiumized by 60 mgm. of pure radium bromide. The pathological examination showed typical cancer invading the cervical tissue. She remains in perfect health without further treatment after eight years." Thus it would appear he was the first to report a "cure" of a proved case of cancer of the cervix treated by radium.

In France, following the early work of Danlos on skin lesions, little interest in radium therapy was displayed until 1906, when, under the auspices of M. Armet de Lisle, the Laboratoire Biologique du Radium was established as a center of research at Paris.

It was in this laboratory that H. Dominici,[20] while studying the biological action of radium on tissue, announced in 1907 the principle of filtration which was to alter the whole course of radium therapeusis. In collaboration with Beaudoin, he demonstrated the homogeneity of the radiation after it had undergone filtration by 0.6 mm. of a dense material, such as lead. Eliminating secondary radiation by another filter of very slightly dense matter, as little as 0.1 mm. of paper, he noted that the rays thus selected presented remarkable properties characterized by a relative innocuousness for healthy tissues, whereas on the other hand, they preserved all their special action in neoplastic tissues. He thus established, says Barcat,[8] the method of ultrapenetrating radiation at a time when official opinion maintained that filtration removed from radium its essential properties.

In the first edition of Radiumtherapie, published in 1909 by Wickham and Degrais,[81] associates of Dominici, no mention is made of this important observation. A radio-uterine apparatus of Wickham, however, is described in which lead and silver screens are used for filtering the radiferous varnish coatings on the stem and cup of the applicator. In the second edition,[82] published in 1912, the following appears, "Metallic tubes (silver, platinum) made by

M. Armet de Lisle at the direction of Dr. Dominici are in current usage."

The evolution of what we now know as the French School of Technique began with the inauguration of a therapeutic service at the Institute of Radium of Paris in 1919 under Regaud, Lacassagne,[42] and their associates. The Curie Foundation, the Pasteur Hospital and the Medico-Surgical Clinic provided the therapeutic material. The set-up was what we call today a Tumor Clinic with a surgeon, an otorhinolaryngologist, a urologist, a dentist and a radiotherapist in consultation. Interstitial radium was tried in 1919, 1920 and 1921, and completely abandoned. All epitheliomas of the cervix in good condition were treated by radiotherapy alone whatever their degree of extension, with the exception of adenocarcinomata, certain pavement cell epitheliomas in bad condition for irradiation (adnexal infection, lack of distensibility of the vagina) and recurrences after curietherapy. These were submitted to surgery.

Their technique, described in 1929, remains essentially unchanged today. An intrauterine sound with two foci of 13.33 mg. and one of 6.6 mg. were placed intrauterinely and two intravaginal pieces, cylinders containing each 13.33 mg., united by a spring (the so-called colpostat) were inserted into the lateral cul-de-sacs. The intrauterine applicator had a filtration of 1 mm. of platinum and the vaginal cylinders or corks 1.5 mm. of platinum.

The irradiation lasts 120 hours. The difference in filtration is legitimate, says Lacassagne,[43] for the uterine epithelium is much less sensitive to radium and it is at the same time practical because the smaller diameter permits in the uterus smaller, less traumatizing tubes, requiring less forced dilatation. The Curie Foundation has always advocated the practice of giving the treatment in one single seance.

Aside from local disinfection which is de rigeur, no preparatory treatment is given except in some advanced cases when transcutaneous radiation may be used. Anesthesia is never given. The total intracavitary dose currently used is 8,000 milligram-element-hours, evenly divided between uterus and vagina. Either telecurietherapy or external roentgen therapy is employed.

With the former (4 gm. of radium, 1 mm. platinum at 10 cm.) and a large lesion invading the parametrium, daily seances, single or fractionated of a total of three or four hours are given for as long as twenty days. The treatment of choice is a combination of transcutaneous roentgen irradiation with intracavitary radium. Roentgen treatment consists in irradiation of large fields by fractionated doses for a relatively long time. The technique as used by Coutard and Baclesse consists of four to eight fields with a medium total dose on the skin of 12,000 r. This necessitates two seances of one and a half hours every day for four to six weeks. Lacassagne recognizes this technique as unsuitable for mass treatment.

Surgical curietherapy or the insertion of tubes or needles charged with radium into the teguments or into the depths of tissues, and roentgen therapy by narrow compact beams of very absorbable rays have never been used at the Institute, writes Regaud,[66] probably unmindful of the work done at at the Institute in 1919, 1920 and 1921.

The technique of the Institut du Radium de Paris is not given in terms of dosimetry, Regaud says, but in terms of accurate observation of the biologic effects (experience) and with emphasis on the complex physical, geometric and radiophysiologic factors because the "dose" in radiotherapy is not the simple and almost independent factor which it is believed to be by common error.

The history of the radium treatment of cancer of the cervix in Sweden began with Forssell in 1910. According to Heyman,[32] he first employed 20 mg. of radium element or less with 0.5 to 1.5 mm. silver filter and a time application of twenty hours. The treatment was often repeated six to ten times at intervals of two to four weeks. The first 40 cases treated according to this method were published by Forssell in

December, 1911. As soon as he obtained more radium he followed the technique indicated by Dominici with larger doses and stronger filtration. In 1913, as much as 72 mg. el. was applied screened with 3 to 4 mm. of lead. At the end of 1913 and beginning of 1914, Forssell elaborated the technique which has been followed in the main ever since: A smaller number (usually three) of intensive treatments (each of about 105–112 mg. el.) with strong filtration (equivalent of 3 to 4 mm. lead) are given in the course of three to four weeks. Afterwards, no application is made except in the case of a recurrence.

In the past ten years, writes Heyman,[34] the technique has been perfected. Coincident intrauterine and vaginal application of radium has been consistently carried out. A typical treatment follows:

In uterus, 33.7 or 40.1 mg. el.
In vagina, about 70 mg. el.
Time: 22 hours—741 to 882 mg-el-hr. in uterus; 1,500 mg-el-hr. in vagina.
Filter—3 mm. lead equivalent.
One week interval, second treatment.
Three week interval, third treatment.
Total: 2,220–2,640 mg-el-hr. in uterus; 4,500 mg-el-hr. in vagina.

Recurrences in the parametria are treated with roentgen rays. This is one of the rare occasions when we nowadays resort to roentgen treatment in carcinoma of the cervix. We have abandoned the combined radium-roentgen treatment since we have found that the results were not better but rather worse than with radium treatment alone.

Writing in 1932, Heyman[35] says, "Only during the last two or three years an additional roentgen or teleradium treatment to the parametrium has been given as part of the roentgen treatment in carcinoma of the cervix."

Still later (1935), after having followed the Stockholm method in 3,000 cases, Heyman[36] writes that since 1929 he gives roentgen irradiation in all cases of cervical cancer three weeks after the last radium treatment but believes he has seen healing with teleradium and "brachy-radium" (endocervical and vaginal) that he did not see with brachy-radium and roentgen treatment.

In a meticulous study, published in 1927, Heyman[32] states, "It seems to me not too bold a conclusion that the radiological treatment as practised at Radium hemmet in respect to absolute results obtained in the treatment of cancer of the uterine cervix is superior to operative treatment." He holds to this in his latest publication[37] where he discusses combined radiological and surgical treatment with special reference to the prophylactic hysterectomy as advocated by Westermark to prevent recurrences. Heyman analyzed 580 early cases in which prophylactic hysterectomy might be advisable and concluded that "in none would a hysterectomy have improved the result." Removing the uterus does not mean the patient will not develop a recurrence.

Interest in the treatment of cancer of the cervix by radium was not lacking in America. Howard Kelly[39] made extensive use of it. Together with Burnam he reported 213 cases treated between 1909 and 1915. Burnam[11] later reported the follow-up of these cases. In a cancer limited to the cervix, a total dose of 3,000 mc-hr. was given, divided into 1,200 mc-hr. in the cervix and 1,800 mc-hr. on the cervix in "a single curative dose." Deep parametrial or paravaginal nodules were treated by the implantation of "emanation points." The statement, "Primary clinical cures in all but the advanced inoperable cases are almost invariable," is made.

Clark[13] began with a dosage of 85 to 100 mg. for twenty-four hours in cervical cancer. He referred to Schauta's diastrous experience in using 50 to 100 mg. of radium for from three to eleven days, repeated in an interval of from twelve to twenty-two days. Later, Clark[14] used 100 mg. applied at one sitting and repeated at a second interval six to eight weeks later. If there was then no improvement, no further radium application was made.

Henry Schmitz[69] in 1915 reported he had

treated 112 cases of malignant growths of various parts of the body with radium. Later, he described his technique in the following words:

> As the therapeutic action of radium extends for a radius of about 4 cm., from 50 to 100 mgm. of radium element are inserted into the uterus if that organ is the seat of carcinoma. Should the uterine canal measure 3″ in length, 75 mgm. are deemed sufficient. If it measures 4″, 100 mgm. and so on.
>
> The "bomb" may carry up to 100 mgm. and is placed directly against the cervix and vaginal vault. The rays will cause a degeneration of carcinomatous tissue within a radius of 1 cm. within 8 hours; within a radius of 2 cm. within 32 hours; and 3 cm. within 72 hours, and so forth. Therefore, a cervical or uterine growth is exposed to the action of the rays for 72 hours, 3 cm. being the average extent of an area which could be effectually influenced by radium rays.

The treatment of cancer of the cervix with radium at the Memorial Hospital, New York, began in 1915 with the advent as chief of Henry Janeway, whom we honor in this commemorative lecture. His acumen is illustrated by those with whom he surrounded himself. Failla and Quimby were appointed physicists. I need not tell you of the world wide indebtedness of radiation therapists to these scientists for their fundamental studies in radiation physics.

Harold Bailey[7] began to treat cancer of the cervix at the Memorial Hospital, New York, in January, 1915. Throughout that year he was not able to command amounts greater than 50 mg. for one dose in an endocervical applicator employing a filtration of 2 mm. of lead and a second vaginal application of a lead capsule in a small tin box 3 by 2 by 1 cm. In 1916, he began to use 100 mc. of radon, with 1 mm. platinum filtration endocervically for three applications one week apart, and later developed the so-called "bomb" technique, consisting of a lead cup (containing 1,000 mc.) fastened to a stiff rod which could be directed against the cervix and to each fornix, so that the vaginal vault received a dosage of 3,000 mc.

In 1919, in an extensive review of Continental European and American literature, Janeway[38] found a radium dosage range of 1,400 mg-hr. to as high as 16,800 mg-hr. in the treatment of cervix cancer. "The dosage generally used has been heavy," he comments, "sufficient to cause sloughing and entirely too heavy for almost any other region of the body."

It is not clear why Janeway credits Krönig[41] with the introduction of the use of radioactivity in gynecology, since his report appeared in 1914. Krönig did not employ or recommend radium endocervically. He used mesothorium vaginally and roentgen rays externally.

The conference on radiation treatment, held during the 15th Convention of the German Gynecological Society[76] at Halle in May, 1913, furnished a great impetus to the treatment of cancer of the uterine cervix by radium.

On this occasion, Bumm of Berlin, Krönig and Gauss of Freiburg, Döderlein of Munich and Krömer of Greifswald, as a group, recognized that radioactivity offered a new hope in the treatment of cervical cancer.

With appropriate bibliographical references Janeway[38] gives in summary the dosage and technique of many of his contemporaries. Massive dosage prevailed generally among the Germans.

Bumm recommends a total dosage of 8,700 mg-hr. to 15,000 mg-hr.

Schauta recommends the use of 50 mg. filtered by 2 mm. of lead, applied for five days or 6,000 mg-hr., and the repetition of this dose in ten days' time, giving thus virtually 12,000 mg-hr.

Latzo and Schueler use the Dominici tubes of 0.5 mm. silver covered with 1.5 to 3 mm. lead and a dosage of 15,300 to 16,800 mg-hr.

Döderlein gives 12,000 to 14,000 mg-hr., in divided doses in the course of one to two months. Weinbrenner gives 8,000 to 13,680 mg-hr. and filters through silver.

For the average favorable case, Janeway believed 6,000 millicurie-hours in one treat-

ment was all that was necessary. He recommended dividing the radium equally among six tubes, the regular Dominici tubes of 0.5 mm. silver or preferably tubes of 1 mm. platinum since the latter filtered out many of the soft gamma rays. Three of these tubes were inserted in the uterocervical canal arranged end to end in a long rubber tube, and three additional tubes were placed against the cervix in modelling compound and allowed to remain for twenty hours.

The number of cases of cancer of the cervix seen at the Memorial Hospital increased so under the stimulus of Janeway and his associates that Healy,[30,31] for the eight year period January 1, 1918, to December 31, 1925, reported 836 cases of primary cancer of the cervix treated with radium. The radium dose for the vaginal applicator was 1,000 to 3,000 mc-hr. and that of the intrauterine tandem 2,000 mc-hr. in the cervical canal and 1,000 mc-hr. above the internal os.

It appears that at about the same chronological period most of the recognized clinics arrived at comparable optimum dosage and filtration for the treatment of primary carcinoma of the cervix without demonstrable extension, viz., about 3,000 mg-hr. intravaginally and 3,000 mg-hr. endocervically, using a filtration the equivalent of 2 mm. of lead.

Once there is secondary involvement, the anatomical situation is no longer ideal for standardized technique, and individualization has been the rule.

Merritt[48,49] was an advocate of intravaginal roentgen irradiation in conjunction with radium and before his recent untimely death he used intravaginal and external roentgen irradiation to the exclusion of radium in his treatment of cancer of the cervix. No five year cure rate has been published for cases so treated.

In an effort to distribute a greater number of sources of radium throughout the tumor bearing area, many therapists have implanted radon tubes, needles and seeds.

Burrows,[12] in 1915, following the work of Stevenson[71] of Dublin, used 50 mg. of radium, 1 mm. silver filtration endocervically, reinforced by two or three needles pushed into the peripheral part of the posterior lip, and two or three, according to the size of the tumor, introduced laterally into the base of the broad ligament and left in situ for twenty-four to forty-eight hours.

Ward[77,78] *et al.* have combined external roentgen irradiation and intracavitary and interstitial radium by using intrauterine applicators and implantation of platinum needles in the periphery of the cervix for crossfire and the vaginal colpostat. Their average dose at the first application is from 3,600 to 4,200 mg-hr., 100 mg. in the canal and four to six platinum needles each containing 12.5 to 13 mg. in the periphery. Ten days later, 75 mg. in a silver colpostat is applied to the vaginal vault and to the right and left vaginal fornices. They have published two year, five year and ten year statistics.

Pitts and Waterman[57] for five years used an intracavitary tandem of two 50 mg. tubes and a pack of 125 mg. against the cervix. In 1925, while in London, Pitts saw Malcolm Donaldson at St. Bartholomew's Hospital using some long platinum needles. These needles were placed partly through the vagina and partly by the intraperitoneal route. From 1926 through 1930, Pitts and Waterman combined an endocervical capsule or tandem with their new needles. Four 3 mg. needles were placed into the tissues at the side of the uterus, two needles on each side. Then 2 mg. needles at 1 to 2 cm. intervals were thrust front and back of the cervix, using in all about twelve to sixteen needles. The radium, all in platinum containers, was left in place seventy-two to ninety-six hours, then later the time was increased to 144 to 168 hours. In this series they did not use external irradiation as a part of the primary treatment. They publish absolute survival rates for 293 cases.

Again in 1939, they[58] report an additional five year series of 135 cases treated with no change in the method except that roent-

gen therapy had been used more freely. Recently, Waterman and Di Leone[79] reported ten year survival rates on 309 cases previously reported for five year survival. Of the whole group (309) absolute, 100 cases survived five years and 69 survived ten years. They added a new five year series of 198 cases. The good results previously reported with the use of interstitial platinum needles of low intensity, they believe, are maintained in this series and with the added use of roentgen therapy (in the last consecutive 109 treated cases) are definitely improved. They recognize a certain inaccuracy in their estimate of dosage figured in milligram-hours and detail the complications met with in 177 cases treated.

Arneson[6] began to use interstitial radiation in cancer of the cervix in 1936 in selected cases and published data for the arrangement of the interstitial sources and the number of milligram-hours of radium required for treatment, taken from publications by Quimby, which gave the amount of radiation required for delivering various threshold doses to specified volumes.

Teahan, Wammock and Weatherwax[73] report 52 cases of cancer of the cervix treated by interstitial radiation applied with the abdomen opened. A pelvic cycle of roentgen irradiation precedes the radium treatment by four weeks. The application is then made under a general anesthetic, the abdomen explored and, if large glands are felt, they are removed. A bimanual examination is then made with the left hand grasping the uterine fundus, while the fingers of the right hand are inserted into the vagina to determine the extent of involvement and plan the distribution of the radium. The cervical os is dilated sufficiently to admit the uterine applicator which is put in position after the radium needles have been implanted. Nine or ten 1 mg. el. needles are placed at the periphery of the cervix parallel to the cervical canal, about 1 cm. apart. These have a filtration of 0.5 mm. Pt, are 21 mm. long and have an active length of 15 mm. Two to four 2 mg. needles are placed in each broad ligament beginning at the periphery of the cervix and extending outward and backward to the pelvic wall, the proximal ends about 1 cm. apart. Two to four radium tubes in tandem are placed in the cervical and uterine canal. The highest tube contains 13.33 mg., while the remainder contains 6.66 mg. The filtration of the tubes is 1.5 mm. Pt and their length is 15 mm. The abdomen is closed and the radium left in position for approximately 260 hours. Weatherwax estimated that the central portion of the cervix receives 45,000 gamma roentgens and the amount reaching points where the needles are placed 24,000 gamma roentgens, which corresponds to a point about 1.5 cm. lateral to the cervical canal, while at 5 cm. from the cervical canal and 0.5 cm. from the pelvic wall, 6,300 gamma roentgens is delivered by the radium alone. If to these are added the x-ray roentgens, at 1.5 cm. one has a total of 25,900 and at 5 cm. 7,800 combined roentgens.

They believe this technique is comparable as far as dosage goes to the ideal one suggested by Sandler, to which we will refer later, and preferable since it is independent of the size of the vagina. It may be noted, however, that the dose delivered to the region in the base of the broad ligament lateral to the cervix is sufficient to produce necrosis and recurrence, the "supralethal effect" of Tod.[74]

Dosage calculations for various combinations of parametrial needles and intracervical tandems were published by Nolan and Quimby[54] in 1943 with special reference to the technique of Waterman and Arneson compared with an ideal set-up of their own applicable to the radium supply available in most well equipped clinics. The dosage and distribution are estimated in gamma roentgens.

It is apparent that one who employs interstitial radium in treatment of cancer of the cervix should be surgically and radiologically trained.

Taussig,[72] on the premise that metastases to lymph nodes are peculiarly resistant to radiation, described a method of

treatment for borderline cancer of the cervix combining irradiation of the primary lesion with surgical removal of a large portion of the tributary lymph nodes. Here again selection of cases is a prime requisite to success. In this report he makes the suggestive statement, "Where heavy radiation preceded the operation, the author found that the lymph glands were more likely to be adherent and difficult to remove."

The effect of external high voltage roentgen radiation or radium properly distributed on regional glands is by no means a settled question. Morton,[50] practicing the Taussig procedure, writes, "If it can be shown that the results of radiation were better when the two were combined than when radium alone was used, it is logical to infer the better results were due to the control or destruction of cancer by roentgen radiation in the areas of primary spread." He[51] reports 65 cases subjected to lymphadenectomy. In 35 cases, the patients received courses of high voltage roentgen radiation in addition to 4,500 mg-hr. of radium to the cervix before operation. The distinctly lower incidence of nodular involvement in his series when the operation was carried out after roentgen irradiation suggests that modern roentgen techniques may make lymphadenectomy unnecessary. Certainly, the results call for an extensive experience, he writes, in cases subjected to preoperative irradiation as compared with those in which no preoperative roentgen irradiation has been employed as this appears to be the crux of the whole matter.

Panhysterectomy, of course, would be the simplest solution of the problem but is applicable to so few. Bonney,[10] who reported 500 Wertheim operations for cancer of the uterine cervix, concluded that the results of irradiation appear equal to the best results of the surgeon and many improve still further.

Meigs[46,47] has recently reported 65 Wertheim operations plus the Taussig lymphadenectomy without primary mortality, truly a surgical triumph. It was done in only 15 per cent of his operable cases, however, a rigidly selected group of thin, young persons in good general health and with an early growth. Cystitis, dilated ureters and hydronephroses are the rule after operation, not the exception, he says, and in 10.6 per cent ureteral fistulae developed, which in all cases will mean ultimate nephrectomy.

Döderlein[19] believed that surgeons were jealous of the accomplishments of radium. Indeed, our own Deaver[17] and Kelly[40] crossed swords over the matter. But, as Morton remarks, the old argument of irradiation vs. operation controversy is unintelligent. What matters only is what will do the greatest good for the greatest number.

As J. G. Clark well said concerning the Wertheim operation, if it were to supplant radium some way would have to be devised to teach more surgeons to do it. So with radiation therapy, some general method of application that is practicable outside of special clinics with resident physicists at hand to calculate dosage on the basis of particular geometrical distributions of radium sources is desirable.

Numerous studies have been made upon the distribution of roentgen radiation within the pelvis showing that the percentage depth dose can be increased by the use of higher voltages, heavier filters, longer distances, larger fields or a combination of these factors. However, no correlated study had been published on the influence of varying specific factors on the distribution of radiation throughout the pelvis until the publication of Arneson and Quimby[4] in 1935.

The distribution of radiation throughout a pelvis of standard dimensions was studied. The average anteroposterior and lateral diameters were 23 cm. and 35 cm. respectively. A diagram of the body contour at the level of the cervix was drawn with these dimensions.

Skin fields of a size suitable were chosen. In order to avoid unnecessary exposure of sensitive tissues and include all of the tumor-bearing region on most patients,

they believe the skin fields should extend from the middle of the symphysis pubis to the iliac crests. Fields with a longitudinal diameter of 15 cm. will usually cover these bony landmarks. The transverse diameter of the irradiated skin area on the anterior and posterior pelvic surfaces should be about 20 cm.

Depth dose charts were prepared according to the method described by Failla and Quimby[22] for fields measuring 15 by 20 and 15 by 10 cm. A mechanically rectified roentgen machine was used with a filter of 0.5 mm. Cu and 2 mm. Al. Data were obtained for target phantom distances of 50 and 70 cm.

Different field arrangements were studied, large single fields 15 by 20 cm. on the anterior and posterior pelvic surface; two fields 15 by 10 cm. on the anterior surface with two on the posterior surface, and the combination of lateral fields 15 by 10 cm. with each of the above plans. Each of the four different field arrangements was studied for target skin distances of 50 and 70 cm.

They found the percentage depth dose could be increased more economically by the use of greater skin distance than by the use of heavier filters.

A six field technique (two anterior, two posterior and one on each lateral surface), oriented in the manner they described with a target skin distance of 70 cm., was found to be the most desirable of the methods investigated by them for the treatment of the extensions of cervical cancer.

Percentage depth doses delivered to the mid pelvis and to points 2 cm. apart up to 12 cm. along a transverse line drawn directly lateral to the cervix for each of the field arrangements and target skin distances considered are published in a readily intelligible graph.

This study was followed by one on the distribution of radiation obtained from several methods of applying radium to cancer of the cervix, based on the premise that the most desirable roentgen distribution to the bony pelvis could be delivered through six fields with a target skin distance of 70 cm.

Arneson[5] assumed certain conditions to be constant as the uterus lying in a place almost parallel to the patient's length, a primary lesion in which the cervix is not destroyed (measuring 3 cm. in diameter) and the fornices free from disease so that radium could be placed lateral to the cervix.

The distribution of radiation obtained from an intrauterine tandem of 3,000 mg-hr. and 5,000 mg-hr. and in combination with other sources of radium, such as needle, bomb, plaque and colpostat for total doses of from 4,500 to 5,000 mg-hr. was investigated.

Arneson recognized that no particular application can be advocated as a routine method of treatment for all patients with cervical cancer but offers his method as most suitable for the average case.

To correlate his study of roentgen distribution in the pelvis with radium distribution, he adopted the threshold erythema dose of Quimby[60] as a unit of measurement. Originally related to external irradiation by roentgen rays or radium, it was later extended to interpret doses from interstitial sources of radium, such as seeds, needles, tandems, and so forth.

Isodose curves were made to note the volume of tissue receiving specified doses throughout the cervix and parametrium and an estimate made of the amount reaching the bladder and rectum.

He found that the tandem for 3,000 mg-hr. delivers 15 threshold erythema doses lateral to the lower capsule to a lesser volume of tissue than the other methods. Combining the bomb or plaque with the tandem increases this volume slightly. If the tandem is combined with needles or used alone for 5,000 mg-hr., 15 threshold erythema doses will be delivered to an even greater volume of tissue. The method employing the tandem and the colpostat delivers this dose at the greatest distance (3 cm.) from the lower capsule. This dose is delivered lateral to the cervix into a volume that is occupied chiefly by the in-

travaginal applicator itself. No region received more than 25 threshold erythema doses. Finally the amount of radiation delivered to the bladder and rectum was found to be about the same as delivered by the techniques shown for the use of the plaque and needles. From these comparisons Arneson concluded that a method for delivering radiation into the lateral fornices in combination with an intrauterine tandem is the most suitable for the treatment of cervical cancer.

Since within reasonable limits of tissue damage, it is impossible to deliver a lethal amount (of threshold erythema doses) of radiation for a distance of more than 3 or 4 cm. lateral to the tandem, external roentgen irradiation is the usual method employed for control of the disease beyond the zone of effect by radium applied to the cervix.

In his earlier paper, Arneson expressed the roentgen distribution throughout the pelvis in terms of percentage of the surface dose. If the amount of radiation delivered to each field is specified, however, the distribution of radiation can be shown in terms of threshold erythemas.

In the belief that most patients will tolerate a dose of 1,500 roentgens (measured in air) to each of six pelvic fields over a period of at least from eighteen to twenty-four days, Arneson shows the distribution of threshold erythema doses for this amount of external irradiation in conjunction with the tandem and colpostat under the conditions specified. From his isodose curves it can be seen that a lethal tumor dose (7 threshold erythema doses) is delivered into the parametrial regions for a distance of 4.5 cm. from the middle of the tandem and 4 threshold erythema doses are delivered almost to the lateral pelvic walls.

He is careful to say that, due to the variation in the anatomical conditions presented by individual patients, no single plan is suitable for the treatment of all cases but he offers his data as representing the maximum amount of radiation that can be delivered safely to most patients. Where the data are not directly applicable they may be used as a basis for approximating the amount of radiation delivered to any particular region.

I have gone into this work of Arneson and Quimby in detail because it seems particularly applicable for the radiation therapist in small communities and small hospitals. The dosage is readily translated into the accepted gamma roentgen unit.

In England, radium treatment of carcinoma of the cervix was slow in being accepted due to the insistence of the surgical members of the profession that hysterectomy was the only method of dealing with the condition.

At the 1912 Obstetrical and Gynecological Section of the Royal Society of Medicine not one word is mentioned of the use of radium.

Mr. Malcolm Donaldson[21] stated in 1930, before the Section of Obstetrics and Electro-therapeutics of the Royal Society of Medicine, that five or six years before he had tried to interest the Obstetric Section in the treatment of carcinoma of the cervix uteri by radium and not only failed but had been denounced as an enthusiast.

Nankivell,[53] of the Radium Committee of Middlesex Hospital, after a six months' visit to the Radium Institute of Paris, writing in 1930 deplored the variety of treatments employed in England which locally fell short of the efficacy of Paris and did not include supplementary treatment to the parametria and pelvic glands. He felt it was little wonder that certain gynecologists still regarded operation as preferable to irradiation.

There, today, modifications of the Paris Radium Institute technique are generally used, comparable to the method just described of Arneson. At Manchester (Holt Radium Institute) Sandler,[67,68] and Tod and Meredith[75] have worked out a dosage system, influenced by the variations in the size and shape of the uterus based on the limiting tolerance of the uterine cervix and, at the same time, delivering a cancericidal dose to an area 2 cm. lateral to the central

canal of the uterus and 2 cm. from the mucous membrane of the lateral fornix in the axis of the uterus to the obturator lymph node, referred to as the "paracervical triangle," roughly pyramidal in shape with its base resting on the lateral fornix and the apex curving round with the anteflexed uterus. No claim of a new technique is made but the advantage of a precalculated dose is stressed. With their system, about 7,200 gamma roentgens are considered adequate for squamous carcinoma when delivered in ten days. Hence, they recommend 4,000 r minimum of roentgen radiation to the parametria (200–250 kv., 40 cm. distance) given within five weeks, but find this possible only if the measurement of the patient's pelvis, from the anterior surface of the symphysis pubis to a point midway between the posterior iliac spines, is 18 cm. or less. It is unnecessary to increase the cervical dose and this is avoided by using an oval applicator with a strip of lead 5 mm. wide running across it, which completely shields the center and only allows scattered radiation to reach the lateral fornix close to the uterus. Patients, whose measurements are such that roentgen treatment is contraindicated, are treated with radium only, delivering 7,200 gamma roentgens throughout the paracervical triangle.

Among other things, one great difficulty of the past has been our inability to compare various irradiation techniques for lack of a common unit of measurement. That we now have and it seems imperative that dosage be expressed in it.

The specification of dosage for radium therapy has been stabilized more slowly than that for roentgen rays. It is probably twenty years since anyone seriously specified roentgen-ray doses in terms of milliampere-minutes, and yet the corresponding term milligram-hours is still with us.

Several factors are responsible for this. Because of differences among roentgen tubes and generators, the establishment of some unit of radiation quantity and standard method of measurement was urgent; the roentgen and standard measuring methods were developed to meet this need. With radium, since a unit quantity always emits the same amount of energy in unit time, the specification of milligram-hours, together with the filter employed, and the size and shape of the applicator contains implicitly a definite statement of the energy leaving the source, which may be called the *emitted dose*. But the quantity reaching the cells to be affected, the *dose delivered* may be an extremely small percentage of this. And a mere statement of milligram-hours, unaccompanied by a statement of other physical factors, is completely meaningless. For instance, 1,000 mg-hr. from a small tube lying on the skin would produce a serious burn, whereas the same amount from a large radium bomb would produce no visible reaction.

Some twenty-five years ago these inconsistencies began to cause criticism, and many efforts were made to establish a unit and a standard method of measurement to agree with those being developed for roentgen rays. For various reasons the problem is much more difficult for radium. A brief review of the steps in the development of radium dosage specification may be of interest.

At first treatments in all types of radium therapy were empirical; radiologists administering them learned from experience and observation just about how much the skin would tolerate from a given applicator, or how many seeds or needles it was safe to insert into masses of various sizes and shapes, in different locations. Little or no correlation was possible between dosages in treatments with different sources.

Before any attempt was made to establish a dosage unit, this question of comparing radiation from different sources was investigated. It was known that a given amount of radium distributed within an applicater of large area does not produce the same reaction as when it is concentrated in a tube or small applicator at the same distance with the same filter. This is inevitable, since in the first case the distance

from part of the radium to any point on the skin under the applicator is greater than in the second case. Furthermore, the rays from these more distant points travel more obliquely through the materials of the applicator, and are hence reduced in intensity by extra filtration.

The general problem of making possible the comparison of radiation from applicators of many shapes and sizes, at various distances, cannot very well be worked out experimentally. The preparation of the many necessary sources and the making of the minimum requisite number of measurements on each is impracticable, if anything else can be done. The much more desirable procedure is to develop a general method of calculating the relative intensities, and then to test experimentally a few of the results thus obtained. A very detailed study of this sort was made by Quimby[59] in 1922. In the published paper were given the *relative* amounts of radiation delivered at the center of the skin field under the applicator by a constant amount of radium distributed uniformly in tubes of various lengths and in circular, square, and rectangular applicators of various areas, for several filtrations and for any distance from 1 to 10 cm. If, now, the number of milligram-hours required to produce any specified reaction with any one of the listed applicators is known, that for any other can be determined. Further, doses can be expressed in fractions or multiples of the amount necessary to express this standard reaction.

At this time, radium doses were beginning to be expressed in terms of "erythema doses." If the number of milligram-hours necessary to produce an erythema with any one of the applicators listed in the table should be determined by trial, then the number required for any other applicator could be calculated. For several such applicators, the erythema doses had already been clinically established, and calculations made according to various ones were found to agree; that is, the relative values in the tables were clinically correct. On this basis, doses for external applicators could be standardized in terms of the erythema dose.

For interstitial sources, similar calculations could be made, but there was no clinical check, and it was necessary to develop experimental methods of determining the validity of the calculations. The first systematic experimental attack on this problem was conducted by Failla and his colleagues[23] at the Memorial Hospital. Studies were first made of unfiltered glass radon seeds, and later of filtered gold seeds and small platinum needles.[24] The fundamental information sought was the manner in which the intensity of radiation decreases in tissue with increasing distance from the tiny sources. This depends, of course, on the geometrical relations (inverse square law as modified by length of source), and on absorption and scattering of the radiations in the tissue. Three experimental methods of approach to this problem were employed, using the bleaching of butter, the production of necrosis in dorsal muscles of rabbits, and the production of erythema in human skin. All of these gave concordant data and showed the practicability of extending calculated tables to interstitial and intracavitary sources. By means of tables thus developed, it is possible, for instance, to determine for any cervix tandem the number of milligram-hours required to deliver any specified number of erythema doses at any specified distance in the tissue.[61,62] Arneson[5] had used this method to advantage in the study of various methods for radium therapy in cancer of the cervix.

For tumor masses implanted with seeds or needles, in order to use such tables for accurate dosage determination at points within a tumor mass, it would be necessary to know the exact positions and orientations of every implant. Then, for any definite point, the dosage contribution for each source would have to be determined from the appropriate chart. This would be extremely laborious, even if possible, but it is very seldom that such a distribution within the tissues can be known accurately. However, in practice, it does not appear

necessary actually to know the dose at every point throughout the mass. Other conditions being equal, it is obvious that if the cells which receive the *minimum* dose within the tumor are destroyed, then all those receiving greater doses will be also. Hence, the dosage problem becomes that of determining the least dose delivered within the diseased region, in any particular instance. This problem was attacked by Quimby and Martin, and a table developed by means of which could be established the number of milligram-hours in small interstitial sources necessary to deliver a minimum of any desired number of erythema doses within a sphere of any reasonable size.[44,63]

All these practical developments centered about expressing radium dosage at the skin, or at points within the tissue, in terms of erythema doses. However, the roentgen had been found such a practical unit for roentgen-ray dosage that it seemed desirable to use it also for radium. The great advantage here is that it would not be necessary to calibrate every radium source, as it is every roentgen tube, or to make depth dosage measurements. A given amount of radium under a constant set of physical conditions of filter, distance, distribution in applicator, etc., always emits just the same amount of radiation. If the number of roentgens delivered at a certain point by any applicator in any of the tables above mentioned could be determined, then the number delivered by any applicator at any distance could be calculated.

The actual working out of this problem involved a great deal of critical experimental work, which cannot be discussed here. Reviews of it may be found in the literature.[25,26,27,28,45] The final result was that a point source of radium, filtered by 0.5 mm. of platinum, delivers 8.47 roentgens at 1 cm. distance. A tube 1 cm. long with 0.5 mm. platinum delivers 7.4 roentgens at a distance of 1 cm. out on a line perpendicular to it at its center, and from the tables first developed for relative doses, the dose can be determined for any applicator, at any distance, for any number of milligram-hours' exposure.

In order to transform the erythema dose tables already mentioned into roentgen tables, it is only necessary to determine the number of gamma roentgens necessary to produce an erythema. Quimby has done this; the number very conveniently comes out to be 1,000.[80] On this basis all her tables have been transformed to specify the number of gamma roentgens per milligram-hour at various distances from various sources.[29] Her latest contribution, and the one most important for dosage determination in cervical cancer, is a table whereby dosage can be determined not only for points opposite the center of a linear source, but for points opposite any portion of it.[65] Thus for a cervix tandem, it is now possible to determine the number of roentgens delivered at any point within the pelvis, for any specified milligram-hour exposure. Furthermore, dosage contributions from combinations of parametrial needles can also be determined. Several other physicists have developed radium dosage schemes of which the most widely used is that of Paterson and Parker.[55,56] Results obtained by all of them are in good agreement.

This review of the development of a measuring unit for radium and roentgen rays at once brings to mind the necessity for thorough grounding in radiation physics of the candidate presenting himself for certification. At the same time, the historical review of the treatment of cancer of the cervix forcefully portrays the impropriety of separating roentgen and radium therapy. Certain (time honored) institutions make no provision for adequate training of their residents in radiation physics. In others, the departments of roentgen and radium therapy are quite separate. Radon is freely rented without consultation, and I am not referring to commercial companies. In some hospitals, residents in the roentgen department see no radium applications unless they go over to the gynecological side as observers and then receive no instruction. Part of this is due to propaganda that

you can do everything with roentgen radiation that can be done with radium. We simply know now that is not so. Radium is indispensable in the treatment of cancer of the cervix. Roentgen radiation has its limitations as has radium. Both are requisites in the treatment of cancer of the cervix. Neither is a benign procedure. This connotes that one should know the indications for and against their use both clinically and radiologically.

Judged by the absolute cure rate even a cursory glance at the literature gives convincing evidence that a combination of external, endocervical and intravaginal irradiation surpasses any other method of dealing with cancer of the cervix.

As Sir Comyns Berkeley[9] said, "The absolute survival rate, i.e., the calculation made from all cases seen whether treated or not eliminates the effects of upgrading and downgrading and is vastly superior to comparison of the gross or net survival rate."

It was not practicable within the scope of this review to discuss many collateral phases of the radiation treatment of cancer of the cervix. Nor was it possible to mention by name the many workers in clinical radiation therapy who have added to our knowledge this past half century or touch upon much of the invaluable research done or in progress by the unsung laboratory scientist. To them all, I humbly offer the praise of mankind for their unstinted labors to eradicate one great scourge of womanhood, cancer of the uterine cervix.

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PRESENTATION OF THE JANEWAY MEDAL

By Douglas Quick, M.D.

Following a very broad college background, Dr. Frederick W. O'Brien, whom we honor as the 1946 Janeway Lecturer, was graduated from Tufts Medical School and shortly after became the first research fellow in radiation physics at Harvard University under the late Professor Duane at that institution. He was later a member of the staff of the Department of Radiology at the Boston City Hospital and alternately, for some years, was a director of that department. He became Professor of Radiology at Tufts Medical School, his alma mater, and is now Professor Emeritus. Dr. O'Brien was President of the American Radium Society in 1941. He has been President of the New England Roentgen Society and is President Elect of the Radiological Society of North America at this time. He has been a Chancellor of the American College of Radiology and is now a representative of the American Radium Society on the American Board of Radiology.

It is a very real pleasure to present this Henry Harrington Janeway Medal, which has been struck in his honor by the American Radium Society, to a grand, fine gentleman—a catholic gentlemen in the very broadest sense of the word. To you, Dr. O'Brien, it gives me very great pleasure to present the Janeway Medal of 1946.

AEROSINUSITIS

WITH SPECIAL REFERENCE TO ROENTGEN DIAGNOSIS

By CAPTAIN JOHN A. COCKE

MEDICAL CORPS, ARMY OF THE UNITED STATES

AEROSINUSITIS has recently become established as a definite clinical entity. Campbell[6,7] has reviewed the literature and discussed its cause, course, and treatment. He considers its incidence rather low—only 1 to 20 as compared with aerotitis. Brouwer, in 1935, expressed the opinion that "sinusitis is an occupational disease of the aviator" and thought it was more common than aerotitis. MacKenzie[10] gives no exact figures but states that in the Royal Canadian Air Force sinus barotrauma (aerosinusitis) has not been so frequent as otitic barotrauma (aerotitis). From my experience in a general hospital in the European Theatre and from conversations with surgeons on combat air bases of the 8th Air Force, I believe the incidence here has been higher than Campbell's figure—i.e. *about* 1 to 4 rather than 1 to 20. Two factors may explain this higher incidence: (1) most men susceptible to aerotitis are screened out during training, and (2) many men in combat continue to fly with mild manifestations of aerosinusitis.

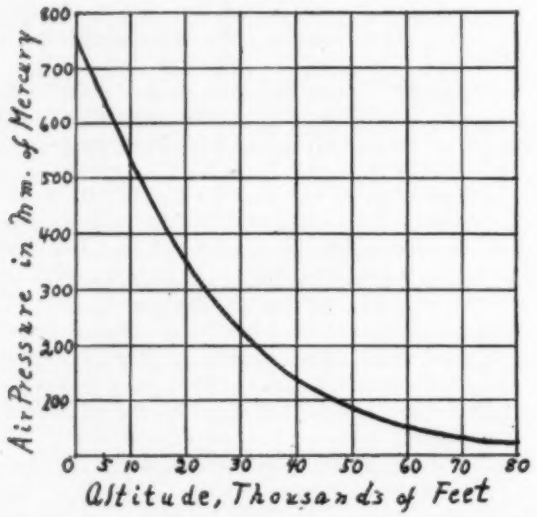

FIG. 1. Graph to show how atmospheric pressure falls as altitude rises. Note that most rapid fall in pressure occurs with altitude changes up to about 30,000 feet.

It is the purpose of this paper to discuss briefly aerosinusitis in general, and special reference is to be made to the roentgen and clinical findings in severe aerosinusitis (Campbell's third degree).

The dynamics of the production of aerosinusitis may be summarized as follows: At high altitude the barometric pressure falls (Fig. 1), and air escapes from the ostium of the sinus. On descent, air tends to go back into the sinus. Where there is no infected material in the nasal cavity and no blockage, air re-enters the sinus and no pathologic condition results.

Non-obstructive aerosinusitis may occur where there is infected material in the nasal cavity, this material arising from other infested sinuses or from the nasal mucosa. This purulent material is forced into the sinus by the increasing atmospheric pressure as the plane descends. However, with a normal sinus mucosa, sinusitis usually does not occur, judging by the comparative infrequency of sinusitis complicating a common head cold in the flyer. When sinusitis does develop in these circumstances, the roentgen appearance and clinical picture is that of any catarrhal or purulent sinusitis as the case may be.

Obstructive aerosinusitis occurs when the nasal ostium of the sinus becomes covered by inflamed mucosa or redundant tissue, forming a ball-valve blockage, so that air cannot re-enter the sinus. I can confirm the experience of others[6,7,10] that this nearly always occurs during descent. With the increasing "negative" pressure in the sinus occurring during descent (Fig. 1), the vascular pressure in the lining membrane would be expected to rise, relatively speak-

ing, in relation to the air pressure in the sinus cavity. This produces edema of the mucosa and transudation of fluid into the sinus cavity. Where the "negative" pressure is very great, rupture of blood vessels may occur with hematoma formation under the mucosa or with bleeding into the sinus cavity.

Campbell classified *obstructive aerosinusitis* accordingly into three groups.

1. *First degree*, where there is only slight pressure differential. Here there is slight transudation of fluid, which releases the block. It is characterized by slight if any pain and usually insufficient symptoms to come to the attention of the physician.

2. *Second degree*, characterized by swelling of the mucosa and transudation of fluid with pain and hyperesthesia over the sinus. Roentgenography demonstrates thickened lining and possibly fluid. These roentgen findings are obviously not specific for aerosinusitis.

3. *Third degree*, in which there is extravasation of blood into the sinus cavity or hematoma under the mucosa of the sinus. It is this group that is of particular interest to the roentgenologist, since it is the demonstration of the submucosal hematoma that points to aerosinusitis as opposed to other sinus disease.

All our cases occurred in combat personnel of heavy bombardment groups stationed in England and flying above 20,000 feet. This approximates Campbell's figure of 18,000 feet and MacKenzie's experimental figure of 25,000 feet as the approximate elevation required for the production of third degree aerosinusitis. A point of interest is that rapid descent is not necessary for the production of hemorrhage in the sinus. All our cases occurred in crews of heavy bombers and these planes usually descend slowly.

We confirm other observers'[6,7,10,14] experience that the frontal sinus is by far the most commonly affected by severe degrees of obstructive aerosinusitis. Campbell suggests four reasons for this: (1) the length and structure of the nasofrontal duct: (2) large sinuses are more often affected (both my experience and MacKenzie's bears this out); (3) the position of the ostium of the frontal sinus lends itself prone to flutter-valve action of the turbinates and redundant or swollen tissue of the turbinates, and (4) the frontal sinuses have no accessory openings.

The symptoms are generally proportional to the gravity of the barotrauma. Where hematoma is found on roentgen examination, the patient's story generally is that of severe frontal pain coming on during descent. Usually it is sudden in onset and sometimes described as like a "bee sting." However, the pain is not severe in all patients. Several in our series continued to fly for several days without reporting to their medical officer. Some patients notice considerable lacrimation on the side of the more severe frontal pain at the time of onset.[10] The history of an acute upper respiratory infection at the time of onset in nearly all our cases emphasizes the role of acute inflammation of the nasal mucosa in this group of combat airmen, in the production of blockage. This factor of acute inflammation fits in with the theory of the mechanism of production of the obstruction —i.e. the inflamed middle turbinate blocks the ostium and air cannot re-enter the sinus when the plane descends.

Von Diringshofen[14] advises vasoconstrictors as spray to reduce nasal congestion and prevent blockage from occurring. Epistaxis may or may not occur. It may be noticed while the patient is still airborne or it may be delayed up to several days. The blood is generally dark and thick, especially where its appearance is delayed.

Prognosis is usually fairly good. We have diagnosed over 30 cases of third degree aerosinusitis by the roentgen findings and only 3 cases were not returned to flying status during the period they were followed. No dangerous complications such as osteitis of the frontal bone occurred in this group. One of Campbell's cases developed a fulminating infection from which he recovered. Two cases had a recurrence of

frontal sinus hematoma on resumption of high altitude flying. Unfortunately, with the turnover in flying personnel, it was not possible to follow up all cases after their return to flying status, so that the incidence of recurrence may well be higher.

None of these cases had any indication for frontal sinus surgery so that operative confirmation of the diagnosis was not feasible.

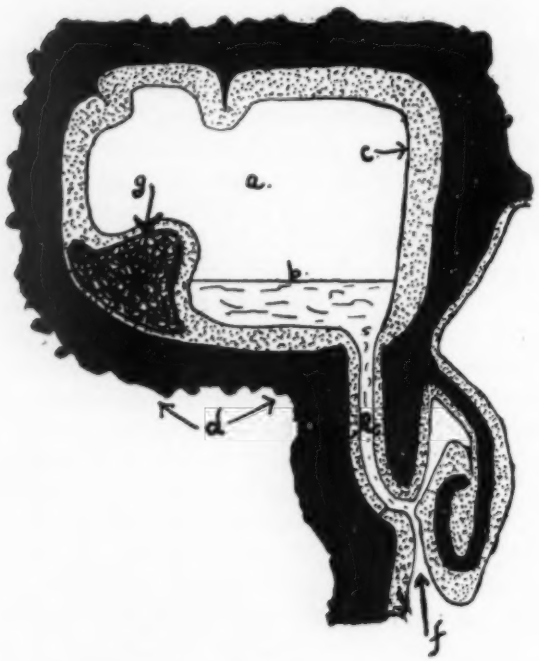

Fig. 2. Diagram to show basis for roentgen signs in frontal aerosinusitis. *a*, air space; *b*, fluid level (with horizontal beam); *c*, edematous mucosa; *d*, bony wall; *e*, nasofrontal duct; *f*, edematous mucosa of middle turbinate blocking ostium of frontal duct; *g*, hematoma under mucosa. Note that hematoma, fluid, and edematous mucosa all have essentially the same radiopacity so that their shadows overlap each other on the roentgenogram.

Roentgenologic investigation consisted routinely in four views: (1) Caldwell (posteroanterior nose-forehead with 23 degree angle board); (2) Waters (posteroanterior nose-chin with 15 degree angle board); (3) lateral, and (4) coronomental. Oblique projections using the optic foramen position occasionally were done. Contrast media were not employed. The posteroanterior projections usually gave most of the information. About half of the cases were roentgenographed in the upright position with the horizontal beam, and fluid levels were occasionally demonstrated in those cases.

The roentgen findings in obstructive, aerosinusitis depend upon the direct effects of barotrauma as illustrated in Figure 2, and evidence of other sinus pathology. They are as follows:

(1) Hematoma in or under the mucosa of the frontal sinus (Fig. 3, 5, 6, 7, 8 and 9). This is evidenced by circumscribed ovoid densities varying from 5 mm. in size to almost complete occupancy of the sinus cavity. This is the characteristic appearance which offers support to a diagnosis of obstructive aerosinusitis as opposed to other sinus disease. These hematomas may be single or multiple and occasionally bilateral. They usually take from two to eight weeks to resolve completely. In one case the density of the hematoma did not resolve completely after four months of treatment and this probably represented permanent residual change due to organization of the clot. Sometimes the shadow of the hematoma increased in size during the first week or two.

(2) General clouding of the frontal sinus (unilateral in all these cases), the density suggesting complete occlusion of the air space (Fig. 4 and 5). This of course is not characteristic of barotrauma but may occur with a very large hematoma, transudate, or blood which fills the sinus cavity. Complicating infection with retained secretions may later cause this appearance also.

(3) Thickened mucosa of the frontal sinus, either due to hyperplasia or acute edema (Fig. 3 and 8). This usually causes blurring of the hematoma shadow, slight clouding of the sinus generally, and the outline of the thickened mucosa can frequently be made out faintly on good quality roentgenograms. The hematoma becomes very sharp in outline and can be better identified in a few days when the edema subsides (Fig. 8, 9 and 10).

(4) Evidence of antral or ethmoid dis-

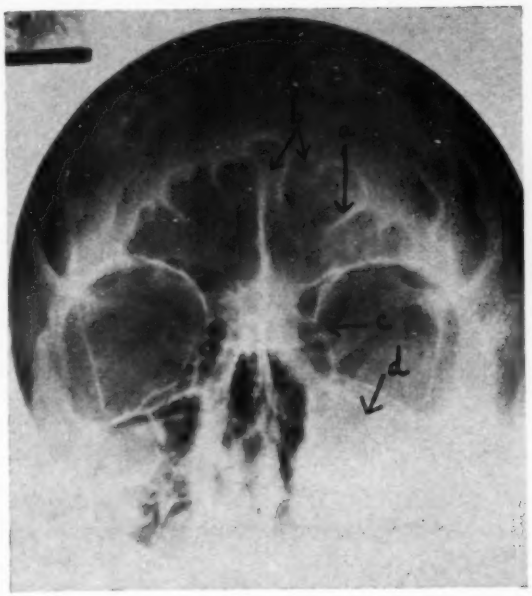

Fig. 3. *a*, hematoma in mucosa; *b*, edematous mucosa; *c*, hazy ethmoids; *d*, opaque antrum.

Fig. 4. Same case as Figure 3, seven days later. *x*, frontal now opaque (fluid); *c*, ethmoids opaque; *d*, antrum opaque. Roentgen appearance now indistinguishable from ordinary pansinusitis, left.

ease has been present in all these cases except one (Fig. 3, 4 and 5). This usually consisted in considerable thickened antral mucosa, sometimes with complete clouding or polypoid changes. Empyema of the antrum requiring irrigations was found in several instances. Most of these cases maintained some thickened lining in the antrum and ethmoids after the frontal had resumed a normal appearance. Pain on descent was never localized over the antrum, which suggests that the changes were the result of non-obstructive aerosinusitis or pre-existing sinus disease. However, from the evidence here, we cannot be sure whether submucosal hemorrhages occur in the an-

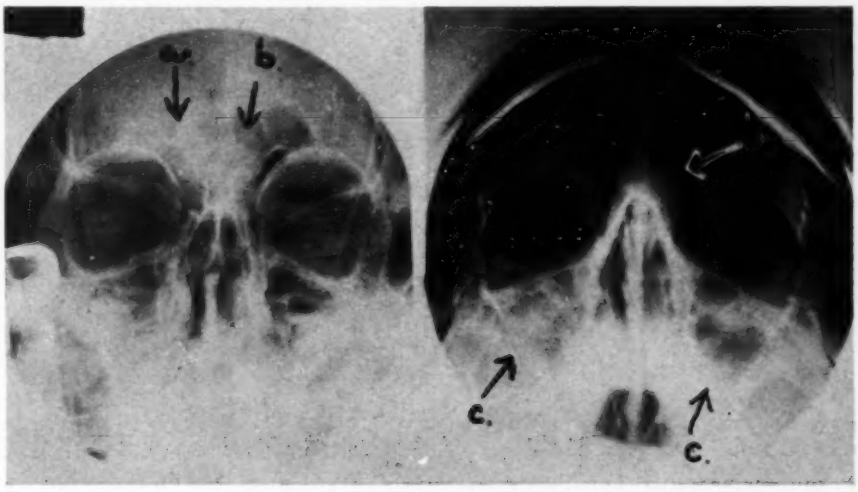

Fig. 5. *a*, right frontal opaque; *b*, hematoma left frontal; *c*, marked thickening of lining mucosa of both antra.

Fig. 6. *a*, bilateral hematomas, frontal sinuses.

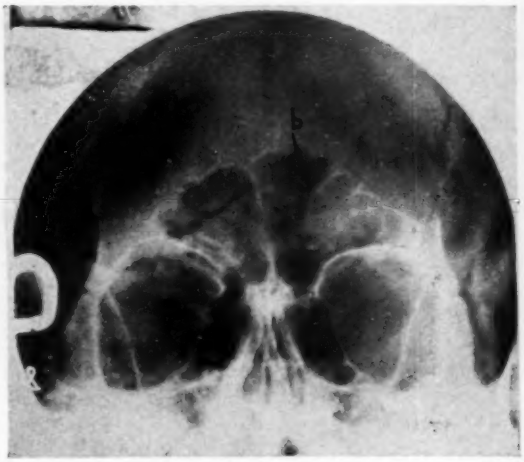

Fig. 7. Same case as Figure 6, seven weeks later. *b*, hematoma which recurred after resumption of flying.

trum or not. The frequency of polypoid change and cysts in the antrum makes this point difficult to settle from roentgen examination. Blood was not obtained from the antrum in several cases which were irrigated. Another hospital in the European Theatre of Operation has obtained old blood from the antrum in a few cases but the possibility that this arose from the

Fig. 8. History of upper respiratory infection four weeks before first roentgenogram shown here, with onset of gradual frontal pain on descent at that time—pain cleared after three days. Later pain recurred and he was grounded. Four weeks later (just before admission) pain recurred on ascent to 25,000 feet, and persisted. *a*, hematoma right frontal sinus; *b*, large hematoma left frontal.

Fig. 9. Same case as Figure 8, nine days later. *c*, sharp margin of hematoma, apparent as edema of mucosa subsides.

hemorrhage in the frontal sinus cannot be excluded.

It should be emphasized that the characteristic rounded density of the hematoma in the frontal sinus may not be seen at the first roentgen examination. This is because the sinus may be full of blood or fluid in the early stage, or later with inflammatory exudate. *Repeated* roentgen examination is frequently necessary to establish the diagnosis. In addition, this helps to differentiate hematoma from other causes of a rounded shadow in the frontal sinus.

The chief differential difficulties lie in polypoid hyperplasia and mucous cysts. Polypoid hyperplasia of this type and appearance is most unusual in the frontal sinus, although very common in the antrum. An allergic history or clinical picture may be helpful in the polypoid case, and a history of high altitude flying in the hematoma case. The history of epistaxis or the observation of blood in the nasal cavity points to aerosinusitis. Cysts generally occur in degenerated mucosa.[11] The hematoma is made hazy in outline by mucosal edema in the early stage and it decreases in size fairly rapidly later, while cysts remain stationary or increase in size over a comparable period of time. Fracture into the frontal sinuses or trauma without fracture has not produced this appearance in a rather large series of injuries to the frontal area seen.

Close cooperation between the otorhinolaryngologist and the roentgenologist is essential here, as in other sinus conditions, in avoiding mistakes in diagnosis, based upon the roentgen appearance alone.

While the incidence of aerosinusitis is not high, it should be considered in the differential diagnosis of sinus disease by the roentgenologist, where the individual is a flyer. It will probably become more generally recognized in the future as high altitude flying and the experimental use of low pressure chambers become more common.

Fig. 10. Same case as Figures 8 and 9, fourteen days after first roentgenogram. *d*, residual of hematomas. Sinuses nearly back to normal appearance.

SUMMARY

1. The mechanism of production and the clinical picture of aerosinusitis are discussed briefly.

2. The roentgen findings in severe aerosinusitis are discussed and illustrated. The characteristic rounded density of submucosal hematoma in the frontal sinus is usually but not always demonstrable at the first roentgen examination.

3. Only the severe forms of obstructive aerosinusitis (third degree), accompanied by submucosal hematoma, may be recognized as such by the roentgenologist.

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ROENTGENOLOGIC FINDINGS IN MYASTHENIA GRAVIS ASSOCIATED WITH THYMIC TUMOR

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AN ABNORMALITY of the thymus gland is present in many cases of myasthenia gravis. According to Blalock, who reviewed the literature up to 1940, tumor or hyperplasia of the thymus gland was present in about half of 110 cases of myasthenia gravis in which operation or necropsy was performed. Since Blalock's review, McEachern has reported 4 cases of myasthenia gravis in which necropsy was performed. In 2 of these cases, a tumor or hyperplasia of the thymus was present. Surgical removal of the thymus gland has been reported by Blalock, Harvey, Ford and Lilienthal, Campbell, Fradkin and Lipetz, and Clagett and Eaton, and by other authors.

The therapeutic value of extirpation of an abnormal thymus gland in cases of myasthenia gravis has not been decided. Clinical improvement has been observed after removal of the gland but spontaneous remissions are common in this disease and judgment as to the efficacy of removal of the thymus must wait until sufficient time has elapsed for a critical analysis.

Very little has been written concerning the roentgenologic examination of patients suffering from myasthenia gravis. Viets, in discussing a paper by Campbell, Fradkin and Lipetz, stated that he had found only 1 tumor of the thymus gland in 85 myasthenic patients whom he examined roentgenographically. Schwab, in discussing the same paper, mentioned injecting air into the anterior mediastinum in an effort to delineate the thymus to better advantage. One death was attributed to the procedure.

Because of the discrepancy between the incidence of thymic abnormality discovered roentgenographically as reported by Viets and the incidence noted at necropsy by Blalock and others, I have made a study of 100 consecutive cases of myasthenia gravis that were observed at the Mayo Clinic since July 1, 1941. In each case the roentgenologic examination included a postero-anterior roentgenogram of the thorax and either a lateral roentgenogram or a roentgenoscopic examination. In many cases roentgenoscopy was performed and a lateral roentgenogram was made.

In 17 of the 100 cases, evidence of a mass in the anterior mediastinum was found at one or more of the roentgenologic examinations. In 1 instance (Case 3) the mass was not recognized at the time of the first roentgenologic examination at the clinic. Attention was called to it by another roentgenologist who had seen the shadow on a roentgenogram which he had made. Review of roentgenograms made at the Clinic disclosed evidence of a tumor which had been overlooked. In another case (Case 8), the impression that a mass was present in the anterior mediastinum was not confirmed by subsequent examinations.

An exploratory operation was performed in 11 of the 17 cases in which a mediastinal mass was found by the roentgenologist. A tumor was found in all of the 11 cases. Ten of these tumors were said to be thymic tumors by the pathologist. In 1 case (Case 4) the tumor was a "hemorrhagic, calcareous necrotic mass." It is not possible, therefore, definitely to state the origin of the tumor in this case. However, because the patient suffered from myasthenia gravis, because roentgen therapy had been applied to the anterior mediastinum prior to operation, and because the site of the mass was typical of the site of a thymic tumor, it is reasonable to assume that the mass represented the necrotic remains of a thymic tumor.

Three of the 17 patients died and ne-

TABLE I

ROENTGENOLOGIC, SURGICAL AND PATHOLOGIC FINDINGS

Case	Duration of Symptoms	Posteroanterior Roentgenograms	Lateral Roentgenograms	Roentgenoscopy	Surgical Findings	Pathologic Findings
1	1 mo.	Poorly defined shadow in region of right hilum	Well defined rounded mass in anterior mediastinum, measuring 6 by 5 cm.	Well defined pulsating mass in anterior mediastinum	Tumor 6 by 5 by 4 cm. in anterior mediastinum	Thymoma
2	6 mo.	Poorly defined shadow projecting from left cardiac border	Well defined oval mass in anterior mediastinum, with broad base to heart and aorta	"Dilated conus" [later "thymic tumor"]	Solid and cystic tumor adherent to anterior part of pericardium	Cystic, fibrous, calcareous, degenerating thymoma
3	3 yr.	Well defined mass projecting from mediastinum toward the right	"Fullness" in anterior mediastinum	Tumor not seen		Nodular thymoma, 5.5 by 5 by 2 cm.
4	1 yr.	Well defined ovoid mass with areas of calcification in periphery, in region of right hilum	Calcified mass in anterior mediastinum	Not done	Calcareous tumor of anterior mediastinum	Hemorrhagic, calcareous, necrotic tissue
5	13 yr.	Tumor not seen	Lobulated shadow in anterior mediastinum; not definitely separate from shadow of aorta	Tumor not seen	Tumor just behind sternum	Thymoma; necrosis of seven-eighths of tumor
6	2 mo.	Poorly defined shadow projecting to left of mediastinum	Lobulated, well defined mass in anterior mediastinum [best seen in oblique projection]	Lobulated mass in anterior mediastinum. Mass did not pulsate		
7	1 yr.	Well defined lobulated mass projecting to the left; fluid in left pleural space	Fluid obscured evidence of mass	Not done	Tumor implants on left pleura. Inoperable tumor of anterior mediastinum	Thymoma
8	3 yr.	Poorly defined shadow along left border of mediastinum; shadow disappeared after roentgen irradiation	Tumor not seen	Tumor not seen		
9	6 mo.	Tumor not seen	Tumor not seen	Plaque-like shadow along left anterior and superior cardiac borders	Tumor of left part of anterior mediastinum	Thymoma, 4 cm. in diameter
10	2 yr.	Well defined mass 6 cm. in diameter, projecting to the right	Well defined mass in anterior mediastinum	Well defined mass in anterior mediastinum	Tumor of right part of anterior mediastinum, invading the superior vena cava	Thymoma, 6.5 by 6 by 4.5 cm.
11	13 mo.	Tumor not seen	Poorly defined shadow in anterior mediastinum	Tumor in anterior mediastinum		Thymoma, 5 by 5 by 2.5 cm.; cystic degeneration
12	6 wk.	Tumor not seen	Poorly defined shadow in anterior mediastinum	Tumor not seen		Thymoma
13	3 yr.	Tumor not seen	Flat lobulated mass closely associated with heart and aorta, situated in anterior mediastinum	Flat mass in anterior mediastinum close to heart and aorta	Flat tumor reaching from sternal notch to upper part of pericardium	Thymoma
14	2 yr.	Poorly defined shadow in the right part of the superior mediastinum	"Fullness" in upper part of anterior mediastinum	Poorly defined mass in upper part of anterior mediastinum	Inoperable tumor invading superior vena cava. Piece of tissue removed for microscopic examination	Thymoma
15	1 yr.	Tumor not seen	"Fullness" in anterior mediastinum	Small, poorly defined mass in anterior mediastinum		
16	13 yr.	Well defined mass in the right part of the anterior mediastinum; mass contained calcium and was 6 cm. in diameter	Well defined mass in the right part of the anterior mediastinum; mass contained calcium and was 6 cm. in diameter	Well defined calcareous mass, 6 cm. in diameter in right half of anterior mediastinum	Tumor in anterior mediastinum	Thymoma, 6 by 5 by 8 cm.
17	1 yr.	Tumor not seen	"Fullness" in anterior mediastinum	Small mass to left of midline at level of arch of the aorta in the anterior mediastinum	Tumor	Thymoma

cropsy was performed. In these 3 cases, the tumor originated in the anterior mediastinum and microscopic examination disclosed a thymic tumor.

In 3 of the 17 cases the presence of an anterior mediastinal tumor has not been confirmed by other than roentgenologic means.

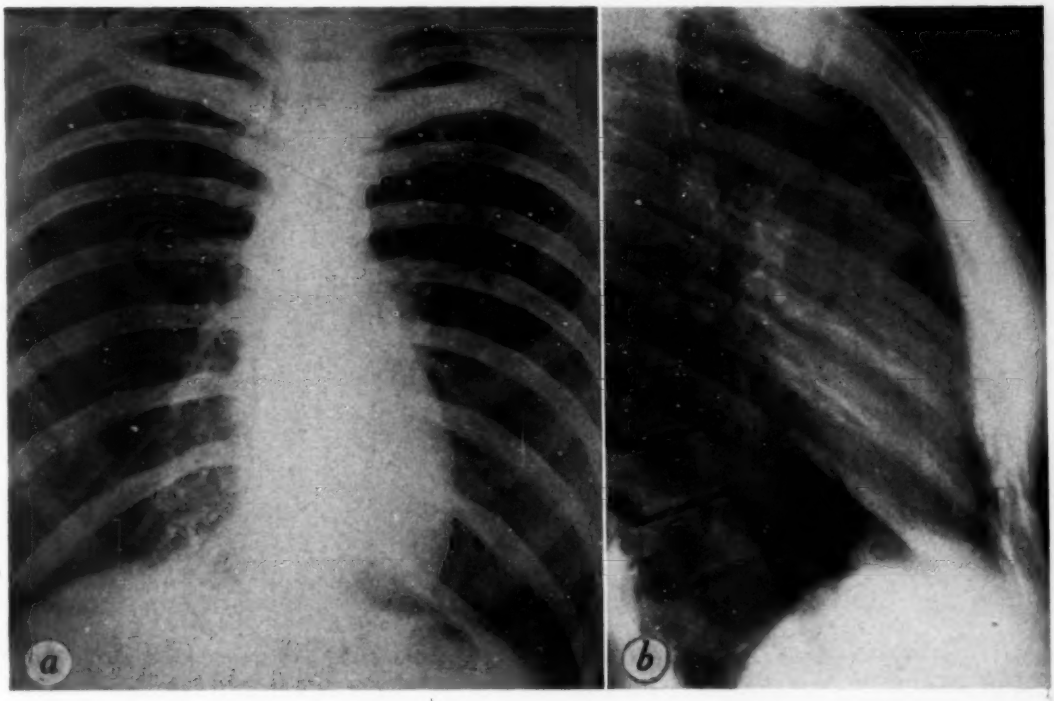

Fig. 1. *a*, posteroanterior roentgenogram which did not reveal evidence of a tumor in the anterior mediastinum in Case 5. *b*, lateral roentgenogram showing a well defined, lobulated shadow in the anterior mediastinum at the level of the arch of the aorta.

The roentgenologic, surgical and pathologic findings in these 17 cases are summarized in Table 1. More detailed reports of the clinical, surgical and pathologic data will be made elsewhere by Eaton, Clagett, and Murray and McDonald.

It is noteworthy that no single type of roentgenologic examination was responsible for the diagnosis in the 17 cases in which tumors were found in the anterior mediastinum. Posteroanterior teleroentgenograms of the thorax were made in every case. In 5 cases (Cases 5, 9, 12, 15 and 17), evidence of a mass could not be seen in the posteroanterior roentgenograms at any time. In 2 of these cases (Cases 5 and 12) (Fig. 1), the tumor was disclosed by lateral roentgenograms; in the 3 remaining cases (Cases 9, 15 and 17), the tumor was disclosed by roentgenoscopy. In 3 other cases (Cases 3, 11 and 13), close study of teleroentgenograms disclosed evidence of a tumor which was not revealed by casual study of the same roentgenograms. In 2 of these cases (Cases 3 and 11), the tumor was not observed when the roentgenograms were first examined.

Roentgenoscopic examination of the thorax was performed in 15 of the 17 cases. In 11 of the 15 cases, this procedure either served to confirm pre-existing roentgenographic evidence of a mass in the anterior mediastinum or was responsible for disclosing such a mass (Fig. 2). In 4 other cases (Cases 3, 5, 8 and 12) no abnormal findings were noted. In 2 of these cases (Cases 3 and 5), roentgenoscopy could not have been adequate since a review of the roentgenograms indicated that a well defined mass was present. In 1 case (Case 8) the presence of a tumor in the anterior mediastinum is doubtful, and in another case (Case 12), a tumor was found later at necropsy although it was not seen by the surgeon at the time of removal of a goiter which extended substernally.

In the 14 cases in which surgical exploration or necropsy confirmed the presence of

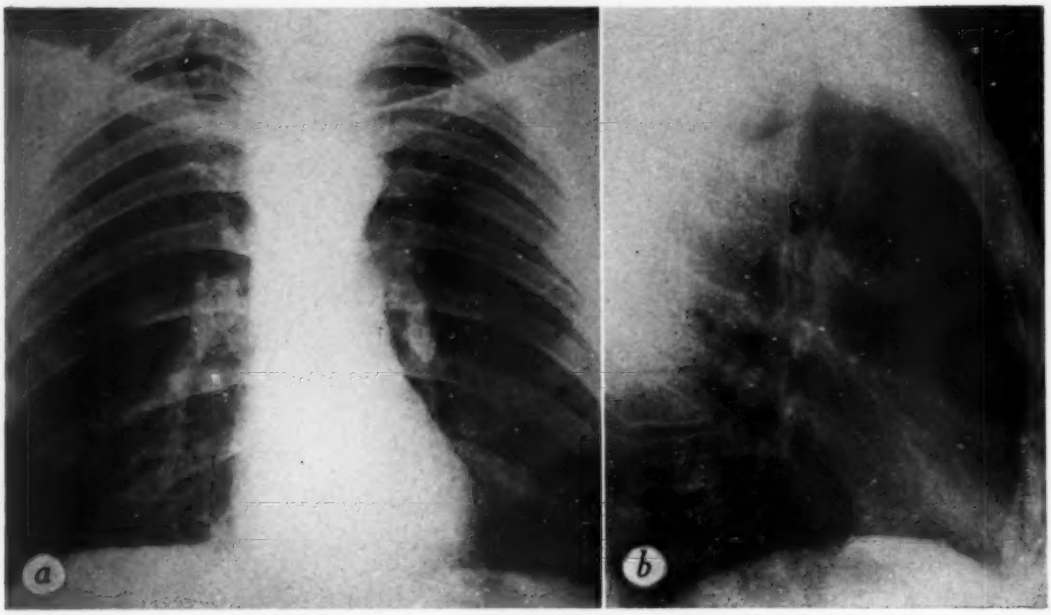

FIG. 2. *a*, posteroanterior teleroentgenogram of the thorax which did not reveal any evidence of a mass in the mediastinum in Case 9. *b*, lateral roentgenogram made in the same case; the anterior mediastinum seems to be clear. The roentgenoscopist reported a plaque-like shadow along the left side of the anterior superior border of the cardiac shadow. A thymoma 4 cm. in diameter was found and removed by the surgeon.

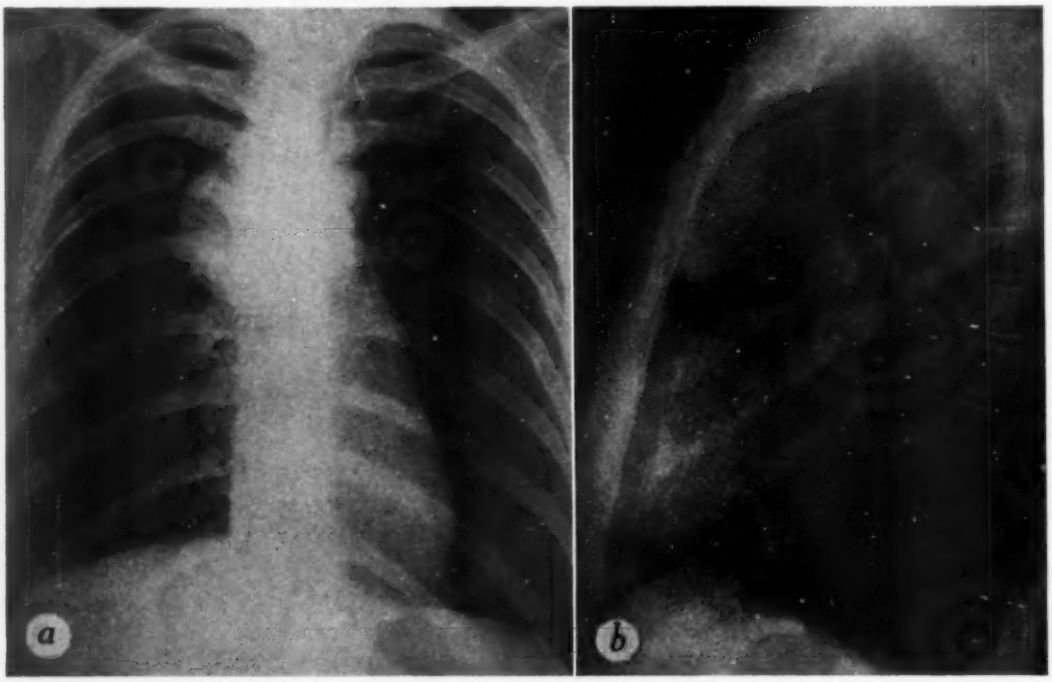

FIG. 3. *a*, tumor at the level of the arch of the aorta in Case 10; *b*, well defined shadow of a thymoma can be seen without difficulty.

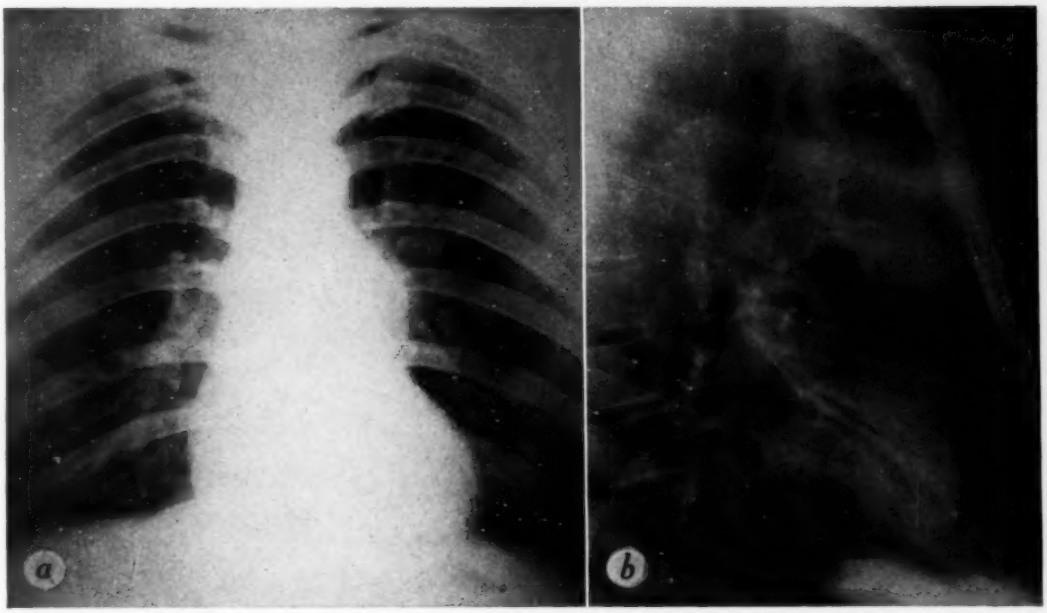

Fig. 4. *a*, shadow extending from the left cardiac border (Case 2) which was thought to represent a dilated conus by the roentgenoscopist; *b*, lateral roentgenogram showing the anterior site of the tumor.

a tumor of the anterior mediastinum, a review of the roentgenologic findings showed that two types of tumor may exist. The first type of tumor produces a well defined shadow on the roentgenogram either because of its large size, its oval or lobulated shape, or because of the presence of calcium. This type of tumor will be disclosed by any type of roentgenologic examination of the thorax (Fig. 3). The other type of tumor may be overlooked because it is shaped like a plaque and is closely attached to the anterior pericardium and the great vessels. The only evidence of the latter type of tumor may be a shadow best described as a "fullness" in the clear space of the anterior mediastinum. Because of its close proximity to the heart and great vessels this shadow may pulsate so as to suggest that the mass represents part of the vascular system. In one of the first cases observed (Case 2), observations by two different observers led to a diagnosis of "dilated conus" (Fig. 4). It was not until after the patient had received a course of roentgen therapy and serial roentgenograms showed a change in contour of the shadow that either examiner was willing to concede that a thymic tumor might be present.

The position of the tumors in the anterior mediastinum in this series of cases varied. For the most part they were found in the upper part of the anterior mediastinum overlying the aortic arch and the base of the heart. None extended above the suprasternal notch. It must be emphasized, however, that a thymic tumor may be situated lower in the thorax. In 3 cases (Cases 1, 4 and 16) the tumors were situated at the level of the ninth thoracic vertebra (Fig. 5).

Deposits of calcium (Fig. 6) were found by the roentgenologist in 2 tumors in this series (Cases 4 and 16). One of these tumors was not proved to be thymic in origin (Case 4). In each of these cases, the calcium was deposited in the periphery of the mass and it appeared to the examiner that the tumors were cystic with calcified walls. In 1 other case (Case 2) deposits of calcium were found by the pathologist but were not noted at the time of the roentgenologic examination.

In several of the cases in this series roent-

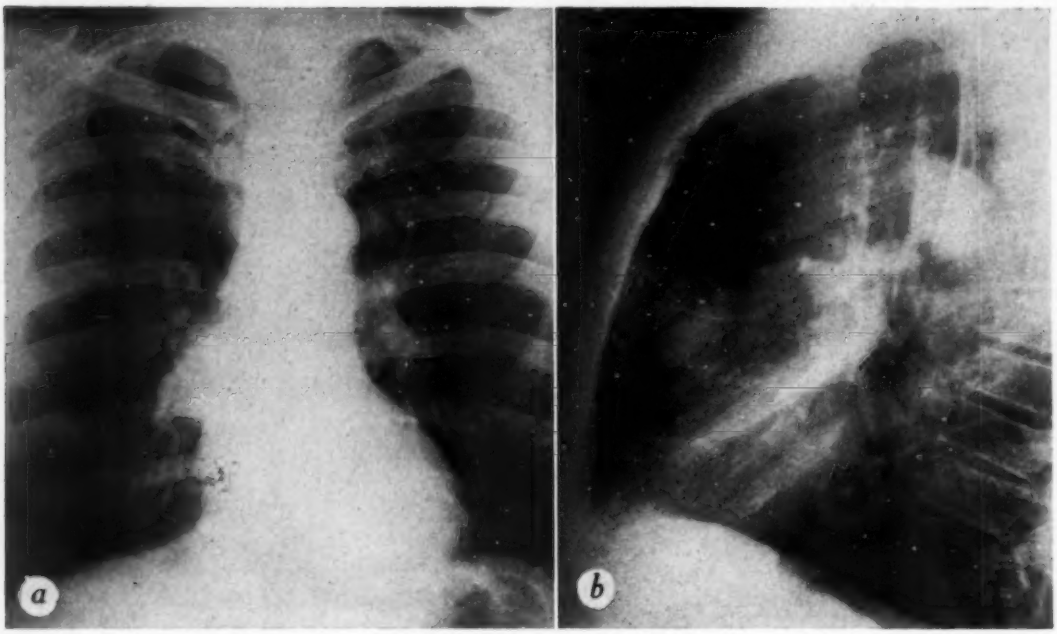

FIG. 5. *a*, poorly defined shadow at level of ninth thoracic vertebra in region of right hilum (Case 1) represents a thymoma 6 by 5 by 4 cm.; *b*, lateral roentgenogram showing well defined rounded shadow of a thymic tumor of the anterior mediastinum.

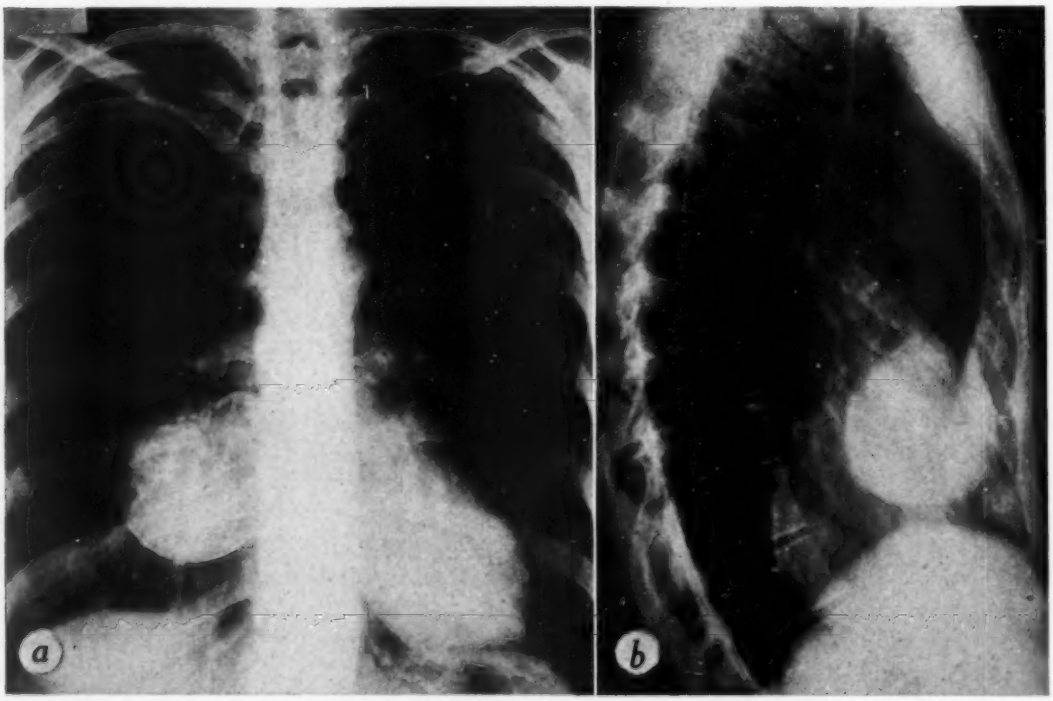

FIG. 6. *a*, large tumor with deposits of calcium in the peripheral portions at the level of the ninth rib in Case 16; *b*, lateral roentgenogram showing the anterior site of the tumor.

gen therapy was applied to the anterior mediastinum before operation. A change in the size or shape of the shadow of the tumor mass was noted in 2 cases only (Cases 2 and 8), and this change was barely perceptible in 1 of these cases (Case 2). The effect of irradiation on tumors of the thymus is not in the province of this report, but it should be noted that, contrary to the impression given in the older literature, there was no rapid or great reduction in size of the tumor in any of the cases.

It is more difficult by using roentgenologic methods to find a tumor of the anterior mediastinum in a case of myasthenia gravis than it is to identify the type of tumor once it has been found. Except for the 1 instance (Case 4) in which the nature of the tumor was in doubt because of extensive necrosis, all of the tumors in this series of cases originated in the thymus gland. It is conceivable that some other type of mediastinal tumor might develop in a case of myasthenia gravis, but the possibility of such a coincidence must be rare.

ROENTGENOLOGIC TECHNIQUE

Because of the difficulty experienced in recognizing some of the tumors in this series of cases the following standard roentgenologic technique now is employed at the Clinic in all cases in which the presence of myasthenia gravis is suspected.

Roentgenoscopic Examination. A careful roentgenoscopic study is made of the mediastinal structures with the patient in all positions. Any abnormal shadow is noted and roentgenograms are made in such positions as will show the shadow to best advantage. Care should be taken to watch the anterolateral borders of the mediastinal shadow as the patient is turned slowly toward each oblique position. Many of the tumors can be seen first as a convex shadow along the margin of the normal shadow of the cardiovascular structures. The curve formed by the lateral limits of this convex shadow is not the curve normally encountered in this region; for this reason, it should arouse the suspicions of the roentgenoscopist. We believe, owing to our experience in this series of cases at the Clinic, that roentgenoscopy is the most important part of the roentgenologic examination in the study of patients suffering from myasthenia gravis.

Posteroanterior Stereoscopic Teleroentgenograms of the Thorax. These are made as a matter of routine and serve to exclude intrapulmonary disease as well as to locate any mediastinal mass.

Lateral Roentgenograms of the Thorax. These also are made in every case and are made so that the beam is centered to pass through the anterior mediastinal space.

Roentgenograms in Special Positions. These are made with or without the use of a moving grid. They are obtained only when the roentgenoscopist believes them necessary.

SUMMARY

In 17 of a series of 100 consecutive cases of myasthenia gravis roentgenologic examination disclosed a tumor in the anterior mediastinum. Exploratory operation was performed in 11 cases and necropsy was performed in 3 other cases. In all but 1 case, microscopic examination demonstrated that the tumor originated in the thymus gland. No single type of roentgenologic examination was responsible for the diagnosis. It was necessary to use roentgenoscopy and lateral roentgenograms as well as the more routine posteroanterior projection. Thymic tumors found in this series have been grouped into two classes according to the ease of roentgenologic recognition. One type is well defined and easily seen in all roentgenograms. The other type is plaque-like in shape and is easily overlooked. In order not to overlook thymic tumors the recommended roentgenologic procedure in all cases of myasthenia gravis consists of roentgenoscopy and lateral roentgenograms of the thorax as well as the more customary stereoscopic roentgenograms made in the frontal projection.

Mayo Clinic
Rochester, Minn.

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DISCUSSION

DR. AUBREY O. HAMPTON, Washington, D. C. Dr. Good in his excellent presentation has shown that myasthenia gravis is associated with a tumor of the thymus in about one case out of six. These two conditions are rare and if they are associated that commonly there must be some relationship. As he stated, if one examines a patient with myasthenia gravis, that is a patient with a clinical diagnosis of myasthenia gravis, every effort should be made to find a tumor of the thymus. A tumor demonstrated in the anterior mediastinum in such patients should be called a thymic tumor, no matter what it looks like or at what level it may occur.

Dr. George Wyatt, in our small series of cases, noted that the inferior margin of a thymic tumor had a pointed shadow. That is, it had the appearance that we had supposed the thymus should have. The lower margin is pointed and I noted in Dr. Good's exhibit that some of his cases had such an appearance. I have seen five or six benign tumors of the thymus and two of these were associated with myasthenia gravis. Three were removed and they were large tumors and the patients had no symptoms whatever either before or after surgery. They were discovered, incidentally, in the men in the Army.

The most interesting feature of Dr. Good's exhibit was the demonstration of small convex shadows at the root of the ascending aorta. I am sure that in the group I have observed at the Massachusetts General Hospital with Dr. Viets of about 80 cases of myasthenia gravis where we found only one tumor, we missed all of these convexities.

The aorta is normally convex at its root on the right side but these, if you look at them closely, are a little different and in one or two the inferior margin of the convexity was pointed. I think perhaps if we used Dr. George Robb's method of injecting diodrast in the aorta it would be quite simple to determine that that convex shadow was not the aorta.

I am interested in the thymus, particularly in children. I think enlargement of the thymus is a most difficult diagnosis to make. I have never known exactly where the thymus should be. The first case of proved thymic tumor that I saw was thought to be a pulmonary conus aneurysm. The patient died of Addison's disease after the thymic tumor failed to respond to irradiation. It was cystic and it showed no histopathological picture suggesting that it would respond to irradiation.

I wish to show several slides. (Slide) If you give a patient a drink of barium, the average swallowing motion is very rapid and there is no barium left in the pyriform sinuses—very little, just streaks. But (slide) if you give a patient with myasthenia gravis a drink of barium the pyriform sinuses remain filled—the patient has a slow swallowing motion. They can't clear the barium from either the tongue, the pyriform sinuses or the esophagus, but if you give the patient physostigmine, it will look like this (slide). In a very short time, physostigmine has the effect of allowing the patient to swallow normally. We used this as a diagnostic test in our group of cases, and it is interesting that it really works. The only difficulty with it is that in the very old patients, over sixty or seventy, you will notice normally slow swallowing motion and some difficulty in the emptying of the pyriform sinuses.

I wish to congratulate Dr. Good. I think he has done an excellent job. The purpose of this meeting is to present papers that are new and good. He has.

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MYELOSCLEROSIS WITH LEUKOERYTHROBLASTIC ANEMIA

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IN 1943 Rosenthal and Erf[6] reviewed the literature and contributed additional observations concerning a disease which they described as myelofibrosis. This disease resembles chronic myelogenous leukemia in many respects, particularly in the peripheral blood findings and in the condition of the organs when the patient dies of the disease. However, the clinical course and certain other features often differ widely from those usually associated with myelogenous leukemia. The condition has been described under various titles including osteosclerotic anemia, myelosclerosis, leukoerythroblastic anemia, myelophthisic anemia, nonleukemic myelosis and agnogenic splenomegaly.[5] The subject comes into the purview of the roentgenologist because many of these cases (about one-third) show deposition of bone in a fibroid marrow which is detectable roentgenologically.

It is hardly within my province to discuss the subject from a pathogenic or histogenic point of view. However, to assist in orientation, the outstanding findings in the disease are summarized.

Certain patients are seen with osteosclerosis in which the bone marrow shows a marked increase in myelogenous elements in the non-fibroid areas, other cells being crowded out. There is marked extramedullary hematopoiesis which is in excess of what could be expected from the degree of marrow replacement and there is a leukoblastic invasion of many organs. These cases are, therefore, classified as chronic myelogenous leukemia.[2] On the other hand, certain cases which remain under observation for several years show an increase in the number of cells of the erythrocyte series as well as in the relative number of immature cells of this type but without a reduction of other marrow elements. Some followed polycythemia vera which was known to be present up to twenty years before the appearance of myelosclerosis and anemia. The difficulty in the interpretation of these cases arises from the fact that in polycythemia vera there is often evidence of leukoblastic activity which is presumably part of the disease. This evidence may be found in the peripheral blood and is described as a leukemoid change. The evidence of abnormal stimulation may develop in the course of the disease when the peripheral blood has been previously normal. The leukoblastic activity is likely to increase progressively and many cases which appear to represent the "spent" phase of polycythemia progress to what pathologists call myelogenous leukemia on the grounds that, at autopsy, there is malignant invasion of the organs. On the other hand, some observers question this designation partly because the clinical course of the disease has differed from the usual course of chronic myelogenous leukemia and partly because the stimulation is not limited to a single cell type. It is well to remember that the hematologic interpretation of the bone marrow is complicated by the therapeutic procedures of roentgen therapy and transfusions which are frequently needed.

Commonly, in the type of myelosclerosis under discussion, an increase of megakaryocytes in the bone marrow or other organs is found, usually with an increase in the platelets. Many observers believe that this is a primary phenomenon and that the disease is properly classified as megakaryocytic leukemia. Others postulate that these cells remain in the fibroid marrow more or less fortuitously but perhaps because of unusual resistance.

The cause of the development of the

fibrosis is unknown. Whether it follows the same stimulation which produces extramedullary hematopoiesis or is secondary to marrow hyperplasia is not yet apparent, although the former seems more likely.

It appears, therefore, that the roentgenologist may interpret myelosclerosis as part of a syndrome representing a single disease which might be classified as atypical myelogenous leukemia or, as it is preferred by some, megakaryocytic leukemia. In this case it is assumed that the disease may be observed in various phases of development and with a widely varying biological tempo. On the other hand, the sclerosis may be thought to be a nonspecific response to one of several more or less unrelated stimuli. However, it is important to recognize that in most cases, regardless of onset, the anemia finally becomes progressive, progressive leukoblastic activity appears and ultimately death occurs with leukemic invasion of the spleen and other organs.

In the past, Albers-Schönberg's disease, otherwise known as marble bones and osteopetrosis, has been included in the consideration of myelosclerosis but this grouping is unwarranted. Although in marble bones there is marked bone condensation with anemia and leukemoid peripheral blood findings, there is agreement among recent authors[4] that in this disease there is a defect in the development of the mesenchymatous elements rather than a fibroblastic reaction to a simulus which also produces extramedullary hematopoeisis.

The roentgen appearance of osteosclerosis is, at first, that of trabeculae which are wider and denser than normal and which are slightly fragmented. This is followed by the deposition of bone in an irregular fashion throughout the marrow so that the entire medullary cavity becomes denser, the trabeculae become confluent and the endosteum merges into the marrow. The degree of these changes varies greatly in individual cases but is more or less uniform throughout the skeleton. Only in the skull is it difficult to pick out distinct abnormalities. In other words, the findings are systemic rather than multicentric. The bone cortices are not thickened. There is no periosteal reaction although the cortex may be split to resemble periostitis.

Differential diagnosis usually is not difficult.[1] There must be considered chronic fluorine poisoning which also is systemic in distribution but has the tendency to be more marked at the ends of the bones. Prostatic metastases may present the same appearance but are apt to be multiostotic rather than systemic. Hodgkin's disease also may conform to this description.[3] In certain stages of lipogranulomatosis of the Chester type, in Gaucher's disease, in lymphosarcoma, and in sickle cell anemia, the areas of destruction may make the remaining trabeculae appear to be larger and thicker than usual but careful analysis will ordinarily prevent erroneous interpretation.

The following cases are examples of the condition under discussion:

REPORT OF CASES

Case I. The patient was a white male, aged fifty-three, admitted October, 1933, having been told he suffered from "aleukemic leukemia." A very large spleen was palpable as well as large nodes in the groin. The first blood count revealed: hemoglobin 53 per cent, red blood cells 3 million per cu. mm., white blood cells 13,000 per cu. mm., myelocytes 13 per cent, myeloblasts 5 per cent, normoblasts 3 per cent, megaloblasts 2 per cent, platelets 310,000 per cu. mm. This patient was treated by occluding the splenic artery.

The patient was readmitted in August, 1934 for a transfusion, the anemia having become more severe. His final admission occurred at the end of 1934 when he had marked ascites and dependent edema. There were several nodular skin infiltrations in the abdominal wall. The final count revealed: white blood cells 88,000 per cu. mm., 42 per cent myeloblasts, 9 per cent myelocytes. The patient died but no autopsy was obtained.

Case II. White female, aged sixty-two, complained of weakness for five years and spontaneous skin hemorrhages for one year. Her first

Fig. 1. Case 1. Male, aged fifty-three, with "leukemoid" peripheral blood findings and huge spleen. Disorganization of the trabecular pattern and new bone formation in the medulla of the radius and femur.

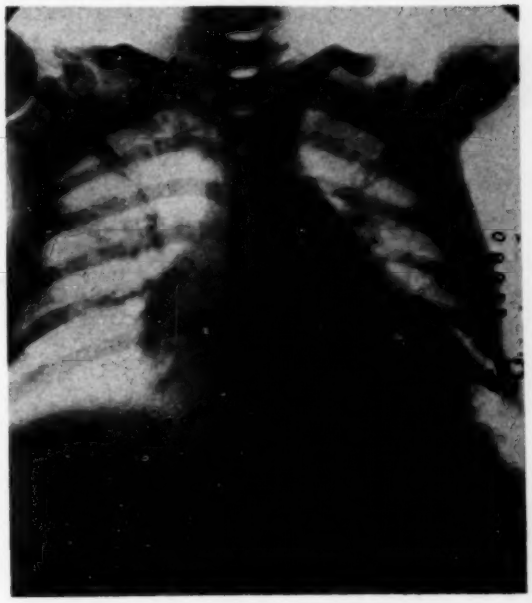

Fig. 2. Case 1. Trabecular reorganization in all of the bones of the thoracic cage.

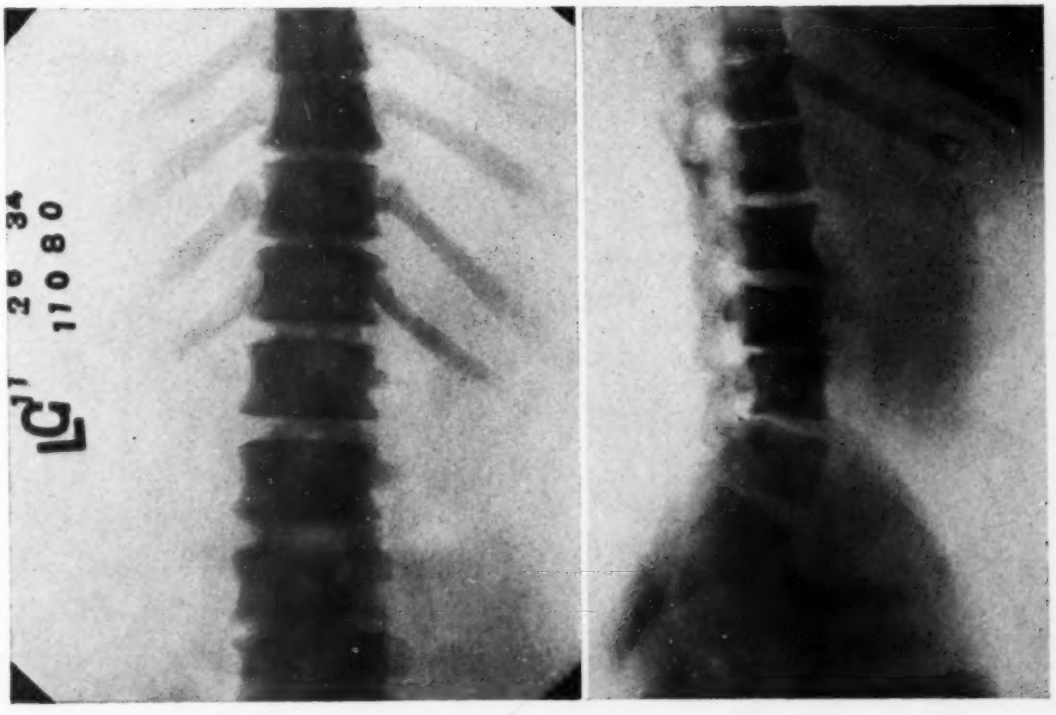

Fig. 3. Case 1. Sclerosis of the lumbar and lower dorsal vertebrae.

Fig. 4. Case I. Trabecular reorganization in the innominate bone and femur.

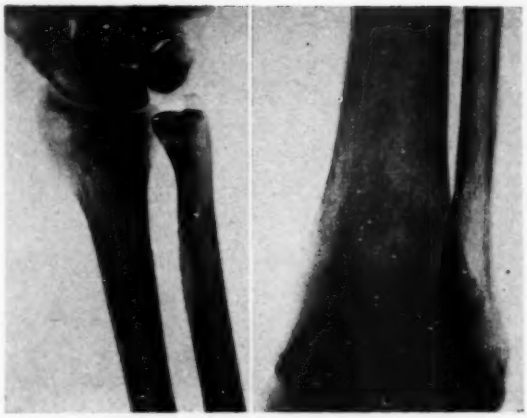

Fig. 5. Case II. Enlarged views of the bones of the extremities to show minimal disturbance in the trabecular structure with focal areas of sclerosis.

admission was in January, 1944, when a profound anemia and marked splenomegaly were noted. The blood count revealed: hemoglobin 42 per cent, red blood cells 2.5 million per cu. mm., white blood cells 41,000 per cu. mm., myeloblasts 9 per cent, promyelocytes 3 per cent, myelocytes 21 per cent. A sternal biopsy revealed a conspicuous number of megakaryocytes in the marrow. The patient received many blood transfusions before she died in August, 1944. The preterminal blood examination revealed: white blood cells 130,000 per cu. mm., myeloblasts 28 per cent, myelocytes 10 per cent, metamyelocytes 17 per cent. The pathologist (Dr. P. Klemperer) reported, from the postmortem examination, that there was involvement of the spleen, liver and bone marrow as in myeloid leukemia. He stated that in view of the absence of destruction of the cellular bone marrow and the presence of typical leukemic organ changes, he considered the case as one of leukemia with osteosclerosis.

Case III. Female, white, aged forty-two, first seen in April, 1932. She complained of headaches and hot flushes for twenty years, dizzy spells for four years, gingival hemorrhage for four months. The patient was plethoric and cyanotic, and had a huge spleen. Blood examination revealed: hemoglobin 154 per cent, red blood cells 9.5 million per cu. mm., platelets 400,000 per cu. mm., white blood cells 12,000 per cu. mm., with a normal differential count; blood volume 193 cc. per kg. The diagnosis was polycythemia vera. She was treated for seven years with radiotherapy, pyridine, small

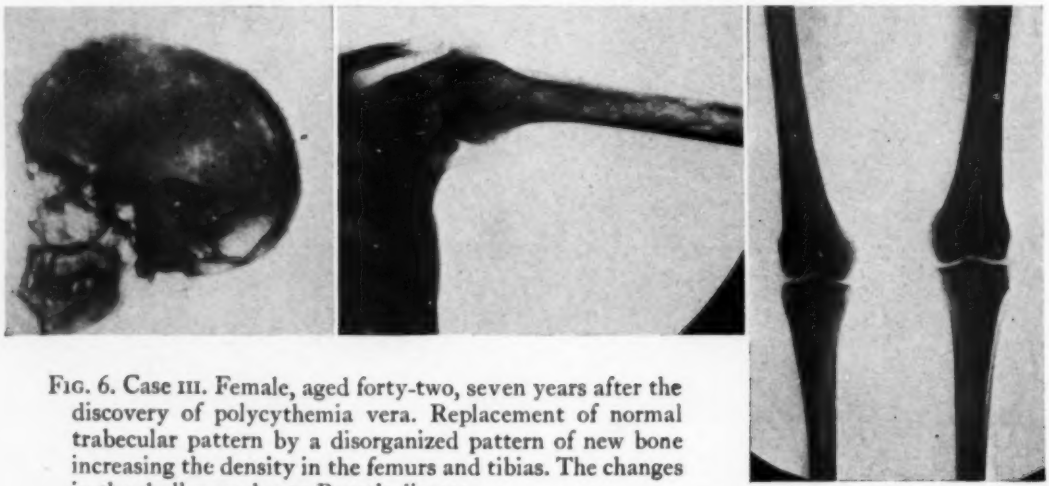

Fig. 6. Case III. Female, aged forty-two, seven years after the discovery of polycythemia vera. Replacement of normal trabecular pattern by a disorganized pattern of new bone increasing the density in the femurs and tibias. The changes in the skull were due to Paget's disease.

phlebotomies as well as one course of Fowler's solution. By February, 1936, her hemoglobin was 100 per cent, red blood cells 5.5 million per cu. mm., white blood cells 11,000 per cu. mm., with a normal differential. Platelets were 150,000 per cu. mm. In June, 1938, the hemoglobin was 65 per cent, white blood cells 31,000 per cu. mm.

The patient was re-admitted in October, 1939, for progressive weakness and dyspnea. Hemoglobin was now 36 per cent, red blood cells 3.5 million per cu. mm., white blood cells 31,000 per cu. mm., myelocytes 6 per cent, myeloblasts 11 per cent, normoblasts 7 per 100 white blood cells. She died after ten weeks, with anemia, leukocytosis and a marked myeloblastic shift to the left. Postmortem examination revealed a huge spleen with extensive myeloid and erythropoietic proliferation and with marked increase in megakaryocytes. There was leukemic infiltration of all organs. Section of the lumbar spine showed areas of replacement of marrow by collagenous tissue, other areas showing cellular marrow rich in cells of the erythropoietic and myeloid series. The pathological note by Dr. P. Klemperer was: "The extensive extramedullary hematopoiesis, although not limited to the formation of myeloid cells, justified the diagnosis of leukemia. The fibrosis of the bone marrow does not seem extensive enough to account for a compensatory blood cell formation of such a degree."

Case iv. Negro waiter, aged fifty-eight, admitted June, 1945, suffering from lower left chest pain for six months. He suffered frequent nosebleeds for twenty-five years but there was no other bleeding tendency. A huge spleen and moderate-sized liver were palpable. Blood examination revealed: hemoglobin 38 per cent, red blood cells 2 million per cu. mm., white blood cells 9,500 per cu. mm., myeloblasts 14 per cent, myelocytes 18 per cent, normoblasts 3 per 100 white blood cells, erythroblasts 1 per cent, platelets 330,000 per cu. mm. Sternal aspiration was not successful in obtaining marrow for study. Sternal biopsy showed advanced osteosclerosis. The other bones examined showed fibroblastic proliferation. There was minimal erythropoiesis and reduced granulopoiesis but with maturation into polymorphonuclear leukocytes. There was a relative increase in megakaryocytes. Splenic aspiration yielded highly cellular material consisting of platelets, normoblasts, erythroblasts, myeloblasts, myelocytes, lymphocytes and a few megakaryocytes. This was considered to represent extramedullary hematopoiesis. Additional blood examinations were essentially the same, except for an increase in the number of platelets. The patient received repeated transfusions and was transferred for chronic care.

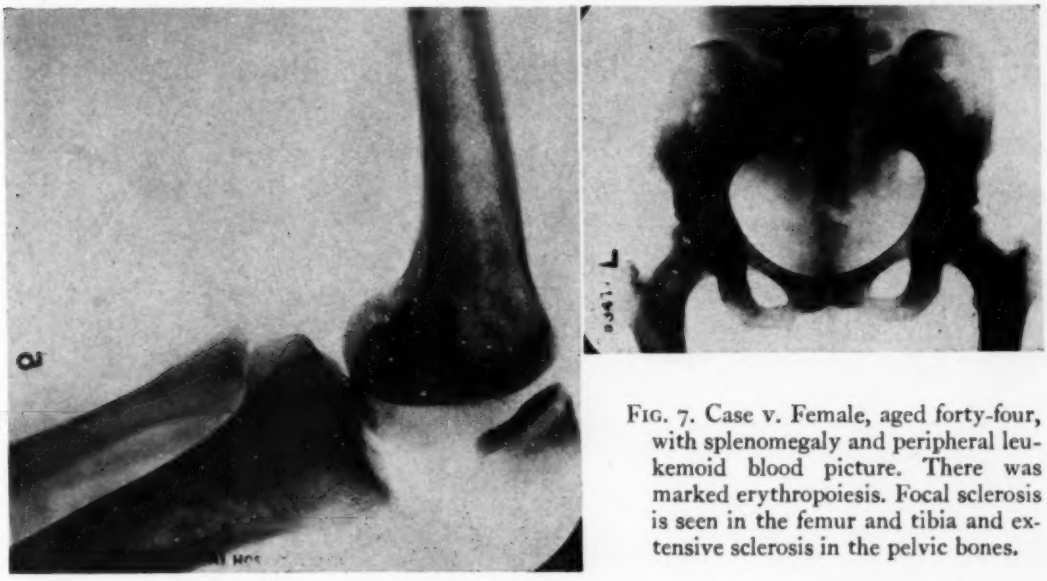

Fig. 7. Case v. Female, aged forty-four, with splenomegaly and peripheral leukemoid blood picture. There was marked erythropoiesis. Focal sclerosis is seen in the femur and tibia and extensive sclerosis in the pelvic bones.

Case v. Female, aged forty-four, first admitted May, 1945, complaining of weakness and exertional dyspnea for one year and a mass

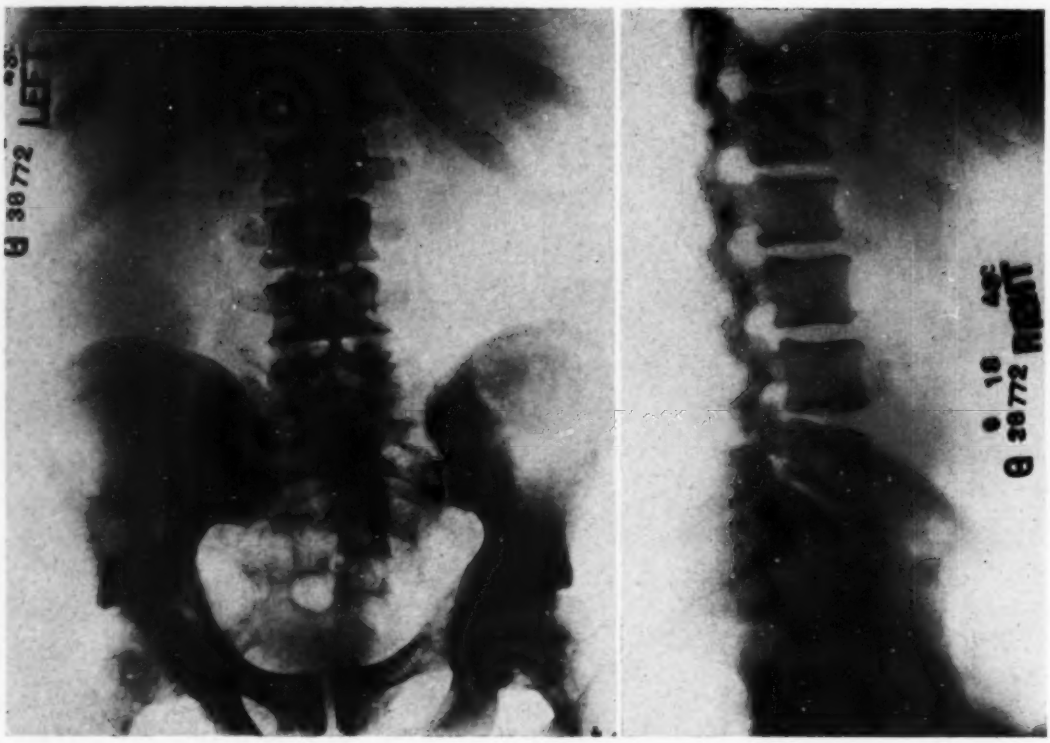

Fig. 8. Case vi. Male, aged sixty-one, with myelosclerosis. One year before, the white blood cell count and differential had been normal but no roentgen examination was made.

in the abdomen which was found to be a huge spleen. Blood examination revealed: hemoglobin 52 per cent, red blood cells 3,600,000 per cu. mm., platelets 400,000 per cu. mm., reticulocytes 3 per cent, normoblasts, 5 per 100 white blood cells. White blood cell count, 7,400 per cu. mm., 6 per cent myelocytes, 1 per cent macrophages. Many of the red cells were elliptical in shape. A splenic puncture revealed an unusual number of erythrogenic elements, including 5 per cent erythroblasts and 21 per cent normoblasts. There were also 2 per cent myeloblasts, 1 per cent promyelocytes, 13 per cent myelocytes. Megakaryocytes were not observed. The bone marrow aspiration showed an increase in erythrogenic elements. The bone marrow biopsy, however, showed a striking increase in megakaryocytes, an increase in metamyelocytes, polymorphonuclear leukocytes and eosinophilic myelocytes, as well as fibroblastic proliferation. The patient was readmitted in June, 1945, by which time the hemoglobin had dropped to 25 per cent and the white blood cells to 2,750 per cu. mm. She was last heard from in July, 1945, when there was some symptomatic improvement.

Case vi. Male, aged sixty-one, first admitted in January, 1943, with progressive weakness and pallor for several weeks. A blood count had been done one year before which showed a hemoglobin of 12 grams. A blood smear and differential were normal except for one normoblast. The patient was found to have an enlarged heart and auricular fibrillation. There was considerable hepatosplenomegaly. Blood examination revealed hemoglobin 70 per cent, white blood cells 8,300 per cu. mm., 2 per cent myelobasts, 5 per cent myelocytes and 3 normoblasts per 100 white blood cells. Sternal marrow aspiration was unsuccessful because of increased density of bone. Bone marrow biopsy showed conspicuous fibrosis. Splenic puncture showed essentially the same picture as the peripheral blood. No evidence could be elicited that polycythemia had been present previously. The patient was admitted for the sixth time in September, 1943, with a pleural effusion. The hemoglobin was 60 per cent, red blood cells 3,500,000 per cu. mm., platelets 45,000, white blood cells 6,700, 3 per cent myeloblasts, 9 per cent myelocytes and 5 per cent metamyelocytes.

Postmortem examination revealed a malignant pleural mesothelioma with generalized metastases. The osteosclerosis, however, was not due to metastatic disease. The marked hepatosplenomegaly was due to extramedullary hematopoesis.

Case vii. Female, white, aged fifty-three, admitted March, 1940. Ten years before, it was discovered that she had a large spleen. She also had a ruddy complexion, headaches and dizziness and was told she had too much blood. At that time (in 1930) the hemoglobin was 40 per cent, red blood cells 3 million per cu. mm., white blood cells 7,000 per cu. mm. with a normal differential. By 1936, her white blood cells had dropped to 5,000 per cu. mm. with 5 per cent myelocytes and 1 per cent myeloblasts. In 1940 the blood count was essentially unchanged except for a greater leukopenia (3,200) and a moderate thrombocytopenia (160,000). Bone marrow aspiration was unsuccessful because of the difficulty of entering the marrow. A bone marrow biopsy showed focal fibrosis of the marrow spaces with thickening of the trabeculae. Splenic puncture revealed extramedullary hematopoiesis. She was last seen in May, 1941, when her hemoglobin was 32 per cent.

Case viii. White male, aged sixty-five entered with a productive cough of ten years duration. He had had an abdominal mass for four years which proved to be a huge spleen. There was slight generalized lymphadenopathy. Blood examination revealed hemoglobin 76 per cent, red blood cells 4 million per cu. mm., white blood cells 22,000 per cu. mm., 17 per cent myelocytes, 1 per cent myeloblasts. Sternal marrow biopsy revealed striking hyperplasia with preponderance of mature neutrophilic myeloid elements and increase in megakaryocytes; erythropoiesis was diminished. There was slight focal fibrosis of marrow. The patient remained under observation for four years and died at another hospital. There

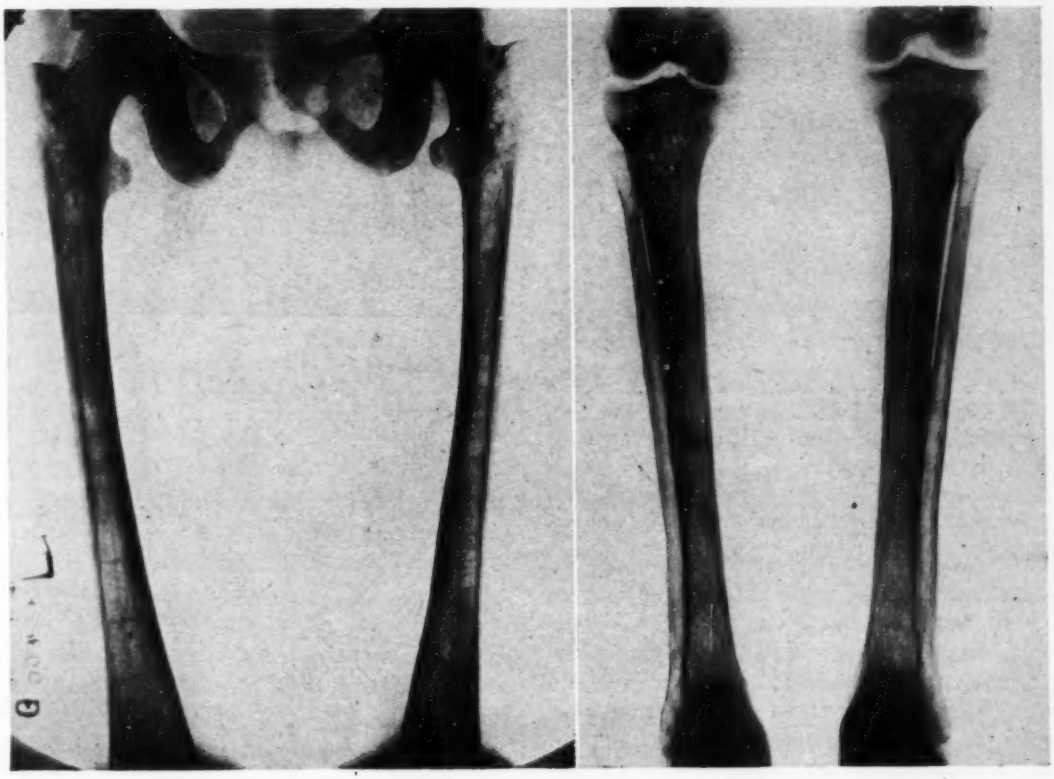

Fig. 9. Case vii. Focal areas of sclerosis, ten years after the discovery of polycythemia vera.

Fig. 10. Case VIII. Slight alteration in the density of the trabeculae which are more compactly arranged than normally so that the medullas have an almost ground-glass appearance.

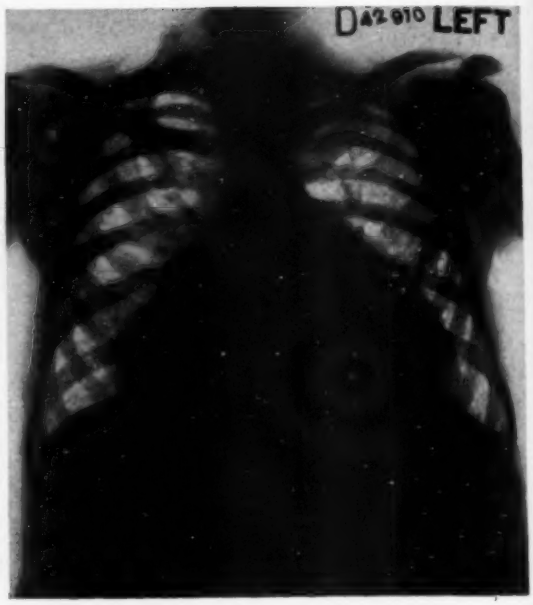

Fig. 11. Case IX. Female, aged sixty-seven, with "chronic myelogenous leukemia" for ten years. The bones of the thorax are uniformly increased in density.

is no information available regarding an autopsy.

Case IX. Female, white, aged sixty-seven, between 1934 and 1943 was admitted to the hospital five times for transfusions. During this time she was considered to have chronic myelogenous leukemia. In 1934, hemoglobin was 63 per cent, white blood cells 4,100 per cu. mm., myelocytes 39 per cent, myeloblasts 8 per cent. In 1943 a sternal marrow puncture was performed by Dr. N. Rosenthal who considered the patient to be suffering from osteosclerotic anemia with a leukemoid blood picture. At this time the hemoglobin was 53 per cent, white blood cells 5,400 per cu. mm., myelocytes 1 per cent, metamyelocytes 6 per cent.

SUMMARY

Nine cases are reported and illustrated in which myelosclerosis was demonstrated roentgenologically in instances of leukoerythroblastic anemia. Differentiation from other conditions associated with myelosclerosis is not difficult when full clinical data are available. Although the disease may be chronic, there is usually progression into frank leukemia as seen at postmortem examination.

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LACUNAR SKULL (LÜCKENSCHÄDEL) OF THE NEWBORN*

REPORT OF SEVEN CASES

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LACUNAR skull, an anomaly of the newborn, associated usually with spina bifida and occasionally with cranium bifidum, was apparently mentioned as early as 1771[25,26] in the literature on forensic medicine. While West[23] is often credited with having reported the first case of this kind in 1875, a year previously Hoffman[10] had published a comprehensive study of the subject. In 1886 White[24] reported the peculiarity as trabeculated skull, and in the same year Goodhart[7] described the condition in an infant of six months and von Recklinghausen[17] in 2 infants, one a seven months fetus and the other a full term baby. He was the first to draw attention to the combination of craniolacunia with spina bifida.

In a comprehensive review of the subject in 1905, Engstler[4] added cases of his own and introduced the name "Lückenschädel." It was not until 1907, however, that Markoe[16] brought the subject into the American literature. Many years elapsed before subsequent publications appeared in the American journals, among them being those by Kerr,[13] Doub and Danzer,[3] and Maier.[15] Interestingly, Maier was able to detect the condition by roentgen examination of the fetus during the eighth month of pregnancy. In 1935 Rothbart[18] added 8 cases to the literature and reviewed the subject comprehensively, and Dorrance[2] in 1940 described the condition in a seventeen year old patient without meningocele or encephalocele.

More recent publications have been those of Hartley and Burnett in 1943[8] and 1944.[9] They were able to collect 28 cases during a period of a year's investigation, the largest number ever published, and they proposed the name craniofenestria for the exaggerated form of the anomaly in which actual associated perforations occurred in the vault bones. In contrast to the previously accepted impression that the condition was quite uncommon, they pointed out that the anomaly occurred in nearly 1 per cent of all births.

Roentgenographically, the peculiarity is characterized by a general diminution in thickness, a variation in density, and a delay in ossification of the flat bones of the skull. The patches of rarefaction or lacunae with interlacing ridges of increased density give a striking appearance readily diagnostic of the abnormality. Particularly in the frontal and parietal areas, where the defects are most commonly present, a soft, rather plastic sensation is often felt on palpation. Grossly, these defects are shallow depressions or deeper cavitations, varying considerably in number, size, and shape, and are found along the inner vault from which they extend to the outer surface.

In spite of the relatively small number of cases reported until recently, the condition obviously occurs more frequently than has been indicated previously in the literature and is often undiagnosed. Surprisingly, too, the anomaly is mentioned infrequently in articles concerning the relatively common spina bifida with which it is so usually associated. Because of the renewed interest in the problem and in view of the controversy concerning the etiology and pathology of this peculiarity, we considered the addition of our cases and our discussion of the subject relevant.

REPORT OF CASES

CASE 1. A.C. (CH 29-1836), a female infant, aged three months, was admitted to the Chil-

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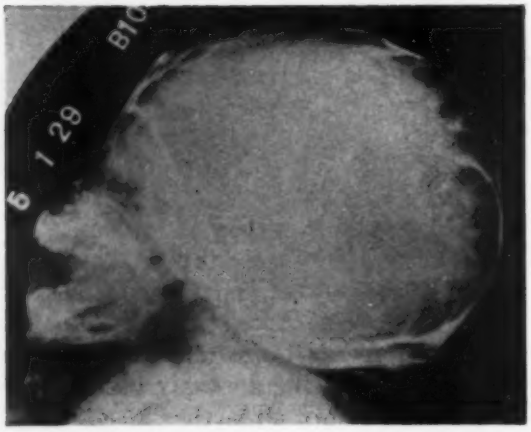

Fig. 1. Case 1. Roentgenogram of the skull, revealing the markings peculiar to lacunar skull.

dren's Hospital of Los Angeles, March, 1929, because of a soft, protuberant mass in the occipital region, noticed since birth. The 8 pound infant was born normally and spontaneously at full term. Other than the cranial anomaly, the development had not been unusual, and with the exception of quite wide, non-bulging fontanels, and a soft, translucent mass in the occipital region, believed to be a cranium bifidum and meningocele, the examination failed to disclose anything unusual. Both the blood Kahn and Wassermann reactions were negative. Roentgenograms of the skull, May 1, 1929 (Fig. 1) disclosed an occipital cranium bifidum and the characteristic picture of lacunar skull. Because of the baby's age, deferment of the meningocele repair was advised, but she was never returned to the clinic and no record of her subsequent progress was available.

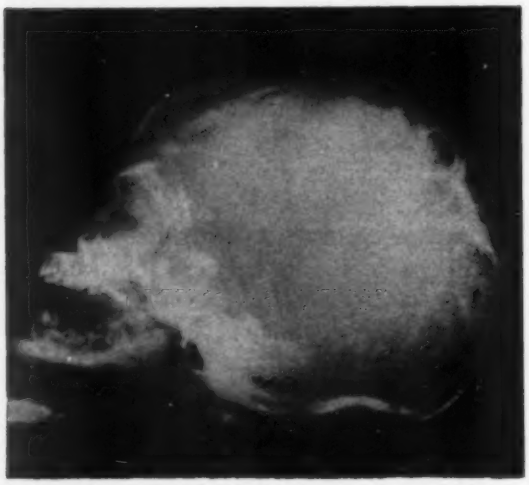

Fig. 2. Case II. Roentgenogram showing lateral view of lacunar skull.

Case II. G.R. (CH 35-3249), a female infant, aged seven days, was admitted to the Children's Hospital October 17, 1935, with a thoracolumbar spina bifida and myelomeningocele. Birth was normal, spontaneous, and full term with a weight of 8 pounds and 11 ounces. A thoracolumbar spina bifida with myelomeningocele and paralysis of the lower extremities as well as a defect of the cranial bones was observed after delivery. A patent sagittal suture, paralyzed and apparently anesthetic lower extremities with clubbing of the left foot, and a large bluish, oval-shaped, thin-walled protrusion in the thoracolumbar region, filled with fluid, suggesting a rachischisis or a myelomeningocele were described in the admission examination. Both the blood Kahn and Wassermann reactions were negative. Roentgenograms of the spine and skull October 21, 1941 disclosed a lumbodorsal spina bifida and an evident lacunar anomaly (Fig. 2 and 3). Inasmuch as no surgical intervention was indicated, the patient was discharged from the hospital

Fig. 3. Case II. Frontal view of lacunar skull.

to be followed in the clinic, but failed to return and no record of the ultimate outcome was available.

Case III. C.T. (CH 37-1564), a female infant, aged two and a half months, was admitted to the Children's Hospital, February 19, 1937, with the history of a fluctuant lumbar mass, and paresis of the lower extremities observed at birth. Delivery was normal and the birth weight was 8 pounds and 12 ounces. At the age of six weeks, the lumbar sac ruptured and continued draining until three weeks prior to hospitalization.

Admission examination revealed a large, intact, fluctuant mass in the lumbar region covered by an attenuated layer of skin. The fontanel was normal in size but under slightly increased pressure. The lower extremities were paralyzed, atrophic, and gave little indication of sensation, and the infant was incontinent. Roentgenograms, February 20, 1937, revealed a picture characteristic of lacunar skull.

The baby died ten days following closure of the myelomeningocele sac. Autopsy diagnosis included hydrocephalus, acute purulent meningitis, and encephalitis, simple cyst of the brain, bilateral bronchopneumonia, hydronephrosis and hydroureters bilaterally, lumbar myelomeningocele, and atrophy of the lower extremities. Unfortunately no examination of the bones of the cranial vault was made. The remnant of the thin-walled cerebral cyst measuring 1.5 cm. in diameter, communicating with the third ventricle and extending toward the posterior portion of the corpus callosum was an additional discovery at the brain examination. Microscopic examination of the hypophysis revealed a multilocular cyst in the region of the anterior lobe filled with pink-staining, finely fiamented, and granular material. It was lined with single layers of flattened cells having a dark, elongated nucleus.

Case IV. S.B. (CH 38-2699), a female infant, aged one month, was admitted September 1, 1938, with the history of a normal, spontaneous full term delivery and birth weight of 6½ pounds. A mass in the lumbosacral region and impaired function of the lower extremities were noted at birth. Prior to hospitalization ulceration and drainage with subsequent healing of the sac had occurred.

On admission the infant was undernourished and cachectic. The anterior fontanel admitted two finger-tips and seemed under moderately increased pressure. A myelomeningocele sac 6 by 7 cm. in diameter and elevated 2 cm. was noted in the lumbosacral region. The overlying skin was darkish-red, parchment-like in thickness, but intact. Pressure on the sac increased the fontanel pressure. No movement of the flaccid right leg and only slight movement of the left leg occurred on painful stimulation. The rectal sphincter was somewhat relaxed. Roentgenograms of the spine disclosed a lumbosacral

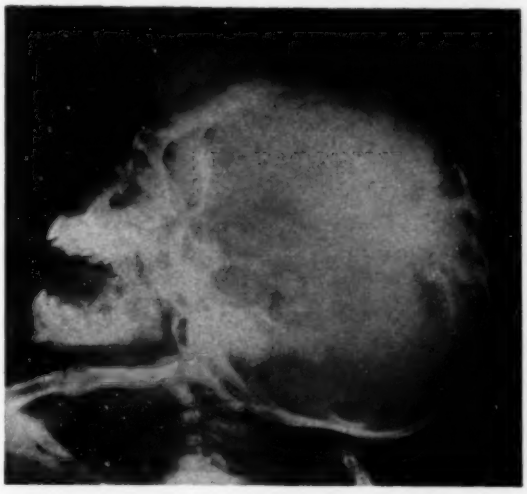

Fig. 4. Case IV. Lateral roentgenogram, again disclosing lacunar skull.

spina bifida, and those of the skull a characteristic picture of lacunar skull (Fig. 4).

The impression was one of lacunar skull, lumbosacral spina bifida, and myelomeningocele with evidence of increased intracranial pressure and paralysis of the lower extremities. Under such circumstances surgical repair of the myelomeningocele was considered contraindicated. Five weeks after admission, the infant was discharged to the outpatient clinic for observation, but no registration occurred and the ultimate course was not determined.

Case V. R.R. (CH 40-1830), a male infant, aged five months, was seen April 1, 1940, at the Children's Hospital Clinic. The delivery had been normal and spontaneous and the birth weight was 6 pounds and 12 ounces. The head was broad and the occipital region quite flattened. The fontanel was not under increased pressure and there was, moreover, no indication of spina bifida nor cranium bifidum. The blood

Fig. 5. Case vi. Photograph showing encephalocele in the occipital region.

Kahn and Wassermann reactions were negative as were those of the mother prior to the patient's birth.

Roentgenograms January 13, 1941, disclosed changes in the posterior parietal and occipital regions characteristic of Lückenschädel. At this time, fourteen months, the infant was unable to lift his head or sit up, and there was some dilatation of the veins of the forehead. The optic discs appeared pale. On May 23, 1941, at eighteen months he was able to raise his head, but could not sit alone. The head circumference

Fig. 6. Case vi. Lateral roentgenogram revealing lacunar skull.

was 19¾ inches and the impression was that of hydrocephalus. Further observation in the clinic was believed advisable.

Case vi. C.R. (CH 41-1077), a female infant, aged one month, was admitted March 25, 1941, with the history of a normal, spontaneous delivery, and birth weight of 6 pounds and 1 ounce. A mass was noted at the base of the skull at

Fig. 7. Case vi. Frontal roentgenogram.

birth. Examination disclosed a small defect in the central portion of the occipital bone from which protruded a soft tissue mass about the size of an orange (Fig. 5). The anterior fontanel was larger than usual and under some tension, but the head appeared small. Because of a loud, high-pitched, blowing systolic murmur heard over the entire precordium, a medical consultation was obtained, as a result of which the diagnosis of a patent interventricular septum

was made. In addition to this congenital anomaly, it was believed the infant had a cranium bifidum in the occipital region with a meningocele and possibly an encephalocele, as well as other congenital cerebral anomalies. Roentgenograms of the skull disclosed a typical Lückenschädel (Fig. 6 and 7). Under the circumstances surgical repair of the meningocele was believed unwarranted and the baby was discharged to be followed by the referring clinic.

Case vii. D.N. (CH 42-866), a male infant, was admitted February 28, 1942, one day after birth with the history of a normal, spontaneous delivery, and a birth weight of 6 pounds and 5 ounces. The baby was moderately spastic, had a clubfoot on the right side, and peculiarly had to be fed entirely by gavage because of an inability to open the jaw more than half an inch. The infant's chin was of the receding type. The diagnosis of arthrogryposis multiplex congenita was entertained though not manifest in the extremities.

Roentgenograms of the mandibular joints demonstrated no pathological condition, but the mandible appeared underdeveloped. Roentgenograms of the spine and hips disclosed nothing unusual, but those of the skull revealed evidence of craniolacunia (Fig. 8).

The baby was discharged on March 25, 1942, to be followed in the outpatient clinic, but no further record of his progress was kept.

Fig. 8. Case vii. Lateral view, showing lacunar skull in the upper parietal region.

COMMENT

The explanation of lacunar skull remains controversial. Among the numerous theories advanced is that of intra-uterine pressure, presented attractively, among other advocates, by Faust.[5] He points out that during intra-uterine life, a physiologic equilibrium is maintained between the intracranial pressure, represented by the brain substance and cerebrospinal fluid, and the extracranial pressure, exerted by the amniotic fluid. With the brain growing more rapidly than the skull during the middle and last months of fetal life, a physiologic delay in skull development occurs which can result in appositional defects and softening along the suture margins. In the presence of a meningocele, a disturbance of the normal hydrodynamics would occur, and it is Faust's belief that the main mechanism in the formation of lacunar skull is the depletion of the normal fluid contents of the subarachnoid space by the reservoir action of the meningocele, which allows a firmer contact between the skull and the brain substance and thus produces a pressure atrophy.

Engstler,[4] although adhering to pressure disturbances as the etiologic agent, believes the defects are not due to pressure atrophy, but to ischemia resulting in poor nutrition and impairment of bone development, the ischemia being caused by an increased intra-uterine pressure.

In a comprehensive review, Wieland[25,26] expresses the belief that increased pressure acting on the incompletely ossified portions of the skull, interferes with its normal development. His histopathologic examinations reveal thinning of the bone in the defective areas with normal new bone formation at the edges. He concludes that this is indicative of resorption secondary to disturbed ossification in turn secondary to mechanical pressure. Similar histopathologic changes are observed by Sicher,[21] Kato,[12] and Loeschske and Weinoldt.[14]

Although not a continuous process because of bone growth occurring at the same time, Loeschke and Weinoldt believe that pressure in young skulls results in absorption of the inner table. Schüller[20] agrees that the condition is primarily one of deficient ossification, rendering the skull less resistant to abnormal pressure. Although Cohn[1] could not exclude the possibility of pressure resorption, he concludes that the process is due to congenital hypostasis, and feels certain before pressure can exert its influence, abnormal ossification of the bone must exist.

In contradistinction, Markoe[16] maintains that the defects do not correspond to the centers of ossification and therefore cannot possibly represent deficiency of ossification. From several of the cases he studied in which there was no demineralization or decalcification of any of the long bones of the body, Rothbart[18] points out there is no systemic disturbance in the mineralization of bone.

Hughes[11] expresses the belief that a nutritional or organic disease, such as rickets or syphilis, is the cause of the condition. On the other hand, although syphilis may produce osteitis and even perforations of the skull, the roentgen appearance is quite different in the lacunar skull. Furthermore many cases have shown negative Wassermann reactions and no further indication of lues and no stigmata of rickets, so that such a conception is hardly tenable as an explanation.

Kerr[13] emphasizes that lacunar skull develops only during intra-uterine life for the reason that after birth the excess intracranial pressure is dissipated in the meningeal sac. Such a point of view is at variance with Faust's[5] opinion that dissipation of pressure is essential for the development of the skull defects. Rothbart[18] believes it reasonable to assume that if the factors instrumental in the development of hydrocephalus could be corrected, the defects of the skull would in time undergo calcification.

If one assumes that the various pressure theories advanced offer the logical solution, one must wonder why the condition is not seen frequently in the numerous cases of hydrocephalus or in some of the cases of oxycephaly, and why it does not invariably occur with meningocele. Moreover, against the theory that increased pressure is the etiologic factor, Weinoldt[22] has pointed out that the intracranial pressure during fetal life is equal throughout with no localizing areas of increased tension.

Although lacunar skull is seen infrequently in the absence of spina bifida or cranium bifidum, it can very well occur alone, as is evident by our fifth and seventh cases. There was also no accompanying meningocele or encephalocele in Dorrance's[2] seventeen year old patient. It would therefore seem that some of the described mechanical theories predicating a meningocele sac in lacunar production would scarcely be tenable.

It seems unlikely the multilocular cyst in the anterior lobe of the hypophysis described in Case III represents anything more than an incidental finding. Subsequent autopsy examinations will be valuable in this regard.

Goodhart,[7] von Recklinghausen,[17] and Schmidt[19] contend that lacunar skull and spina bifida have the same etiology, both being indicative of a congenital developmental imperfection. And in many instances, of course, there are anomalies additional to lacunar skull. Doub and Danzer[3] reported 2 cases with other associated abnormalities, one of them having a cardiac lesion and the other deformities of the vertebrae and ribs. In one of von Recklinghausen's cases the radius was absent and the humerus deformed. In 3 of Rothbart's 8 reported cases, the patients had congenital anomalies besides lacunar skull.

In addition to lacunar skull, the following congenital anomalies can be listed in our cases: Case I, an occipital cranium bifidum and encephalocele; Case II, a thoracolumbar spina bifida and myelomeningocele; Case III, a lumbar spina

bifida with a myelomeningocele, porencephaly, hydrocephalus, and a multilocular cyst in the anterior lobe of the hypophysis; Case IV, a lumbosacral spina bifida with a myelomeningocele; Case V, hydrocephalus and mental retardation; Case VI, occipital cranium bifidum and meningocele and a congenital cardiac lesion diagnosed as a patent interventricular septum; and Case VII, arthrogryposis, micrognathia and a clubfoot on the right side.

Certainly in recent years opinion concerning the etiology of this interesting condition has been increasingly away from the hypotheses of intracranial intrauterine pressure of one kind or another, and has inclined to the belief of some congenital developmental imperfection. In 1943 Fry[6] described 2 cases of spina bifida occurring in binovular twins, and concluded the cause was basically a developmental anomaly not due to a mechanical agent nor to an external influence. During the same year Hartley and Burnett[8] expressed the opinion that both craniolacunia and craniofenestria are purely developmental anomalies similar to spina bifida, occurring usually in association with it, but also separately. In 1944, however, these same authors,[9] as the result of their study of a case of partial or circumscribed craniolacunia were more inclined to believe that the condition results from some nutritional deficiency.

The presence of multiple congenital anomalies is not uncommon, and although in such cases one cannot necessarily regard all abnormalities as congenital, they usually are. Moreover, the impossibility of explaining satisfactorily all cases of lacunar skull by any of the numerous other theories advanced favors some kind of congenital developmental imperfection as the explanation unless evidence more convincing than has heretofore been presented makes its appearance.

SUMMARY

1. Seven cases of lacunar skull or Lückenschädel are described. All were associated with congenital abnormalities. Cases V and VII revealed no indication of either cranium bifidum or spina bifida but did show hydrocephalus and developmental retardation in one instance and disturbances of the temperomandibular joints, micrognathia and clubfoot in the other.

2. The subject is reviewed briefly and various theories concerning the etiology are discussed.

3. It is believed that some type of chromosomal developmental defect offers a more plausible explanation for the cause of the condition than the other theories advanced.

4. In spite of the relatively small number of cases reported until recently, the condition obviously occurs more frequently than has been indicated previously in the literature, and is often undiagnosed.

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Vol. 57, No. 3

AMEBIASIS

A ROENTGEN STUDY OF RELATIVELY EARLY GASTROINTESTINAL FINDINGS

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WHEREAS the literature contains considerable information concerning the roentgen manifestations of chronic amebiasis little has been written about the roentgen changes occurring early in the disease. The present communication, therefore, will concern the latter.

Serving in an American Hospital in the China-India-Burma Theatre of War we had ample opportunity to watch amebiasis develop in American troops sent to us with symptoms for barium studies of the gastrointestinal tract. As a rule, there was little difficulty in determining when the disease was contracted. Every soldier knew where and how long he had been in this part of the world. Knowing he had no gastrointestinal symptoms before going overseas, the man rarely had trouble in estimating the duration of his illness. While errors in these estimations must have occurred, we felt confident the majority were reliable. We believed, therefore, that our gastrointestinal examinations were made relatively early in the course of the disease, that is, from two to eight months after its onset.

It is not within the province of this report to discuss the etiology, pathology or clinical manifestations of amebiasis. Nor is it our purpose to review the roentgenological changes observed in the chronic forms of the disease. This discussion will be limited to the findings in patients in whom the disease was considered less than one year in duration.

MATERIAL

Ninety-two patients, 60 asymptomatic individuals who passed cysts, and 30 individuals with amebic dysentery, were examined by roentgen methods. Of these, 39 had barium studies of the small intestine. All 92 patients were given barium enemas.

ROENTGEN TECHNIQUE

All small intestinal examinations were performed in the morning, the patients having fasted for at least ten hours. The contrast medium consisted of 5 ounces of barium sulfate suspended in 5 ounces of distilled water. The patients were examined roentgenoscopically in the erect and horizontal positions. They were then viewed roentgenoscopically or roentgenographically at half hour intervals for the first one and one-half to two hours and every hour thereafter until the meal appeared in the cecum.

The barium enemas were done under roentgenoscopic guidance. The large intestine was carefully palpated and points of tenderness recorded. Roentgenograms were made in the prone position and occasionally in each anterior oblique projection. Patients were then allowed to evacuate following which they were re-examined roentgenoscopically and roentgenographically. Routine air insufflation of the colon was not practiced because of the field conditions under which we were working.

ROENTGEN FINDINGS

Upper Intestinal Tract. All of the patients (32) with amebic dysentery had barium studies of the small intestinal tract. In addition 7 asymptomatic cyst passers were examined.

Of the 32 patients with amebic dysentery, 28 revealed abnormalities in the small

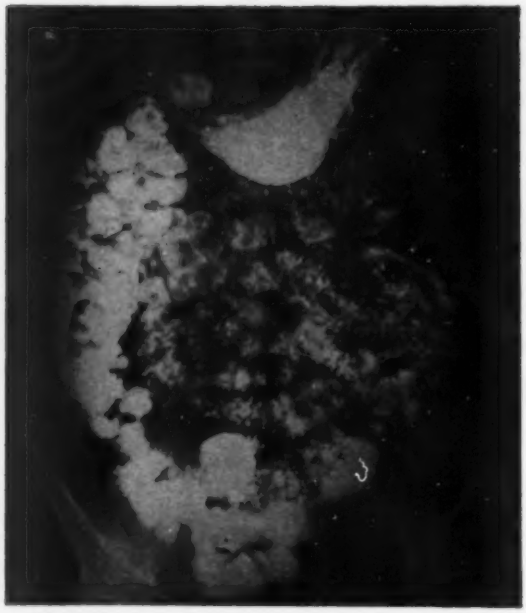

Fig. 1. Amebiasis. Asymptomatic cyst carrier. Roentgenogram obtained one-half hour after barium given by mouth. Head of meal in splenic flexure indicating rapid motility. Slightly increased tone in small intestine.

intestine. In all but one of the asymptomatic cyst carriers the small intestine was normal.

The esophagus revealed nothing unusual.

Nothing noteworthy was found in the stomach. Its tone, peristalsis, and rugal pattern were normal. Gastric emptying time was normal with but one exception, when it was delayed.

As a rule the entire duodenum was normal. Occasionally, the cap seemed irritable. One patient had a duodenal ulcer.

Small intestinal motility was considered normal when the barium entered the cecum in one and one-half to three hours. Patients were considered to have "rapid motility" when the barium entered the cecum in less than one hour. "Delayed motility" was recorded in those individuals in whom the barium took longer than three hours to reach the ileocecal junction.

Of the 39 patients in whom small intestinal studies were obtained, 21 revealed unusually rapid small intestinal motility, the barium entering the cecum in approximately one-half hour. Indeed, it was not unusual to find the head of the meal in the distal colon within one hour (Fig. 1). Five additional patients had slightly increased motility, the barium entering the cecum in less than one and one-half hours. Thus, 26 of 39 patients, or two-thirds, presented rapid small intestinal motility.

The small intestinal pattern in these patients was usually normal. Occasionally, increased tone and bolus formation were present. The latter were noticed particularly in the occasional patient with amebiasis in whom hookworm disease was also present (Fig. 2). A few individuals revealed decreased tone with dilated small intestinal loops (Fig. 3).

Rhythmic segmental contractions in the small intestine were usually normal. Sometimes they seemed slightly exaggerated, in others they could not be visualized. Peristalsis was also essentially normal. When observed roentgenoscopically, particularly

Fig. 2. Amebiasis plus hookworm. Roentgenogram obtained one hour after barium given by mouth. Head of meal in sigmoid indicating rapid motility. Note segmentation and bolus formation in small intestine. Patient developed abdominal cramps and tenderness over the sigmoid while convalescing from scrub typhus. Routine stool study revealed *E. histolytica* and hookworm.

in individuals with dilated intestinal loops, the barium seemed to meet no resistance as it progressed through the small intestine (Fig. 3). The impression was gained that the small intestine was passive and that barium just poured through it. Well defined mucosal folds were always noted, however, and occasionally they seemed more prominent than normal.

Nothing significant was observed in the terminal ileum. As a rule it was normal. In a few it was hypotonic (Fig. 3). There was no patient in whom an irritable terminal ileum was recorded. (It must be remembered, however, that the literature refers to lesions in the terminal ileum at autopsy.)

The small intestinal loops were soft and pliable when manipulated under roentgenoscopic control. Tenderness was noted rarely.

Considerable difference seemed to exist between the appearance of a cecum demonstrated by the oral meal and the same cecum when outlined by barium enema.

Fig. 3. Amebiasis. Roentgenogram obtained one-half hour after barium given by mouth. Head of meal in ascending colon. Note hypotonic appearance of entire ileum and unusual dilatation of its distal segment. The mucosal folds are clearly defined in the proximal ileum and jejunum. Patient complained of weight loss and vague cramps for three months.

Fig. 4. Amebiasis. Roentgenogram after barium by mouth. Note cecal distortion. Patient complained of cramps, diarrhea and tenderness for several months.

Not infrequently the oral meal revealed an irritable, non-retentive cecum which looked normal by barium enema (Fig. 4). This suggested that the oral meal was a more sensitive and more reliable indication of an irritable cecum in early amebic typhlitis than the retrograde barium study, an observation reported previously by Golden.[1]

Three patients revealed delayed small intestinal motility with increased tone, segmentation and bolus formation. One complained of abdominal cramps and had hookworm infestation as well as amebiasis. The second patient had less severe cramps but also had ankylostomiasis. The third with minor intestinal complaints, had cecal irritability and tenderness.

Large Intestine. All patients in this series were given barium enemas (60 asymptomatic cyst passers and 32 individuals with amebic dysentery).

Of the 60 asymptomatic carriers, 46 were examined proctoscopically; all were negative. When examined by barium enema, minor abnormalities were noted which

[1] Golden, Ross. Radiologic Examination of the Small Intestine. J. B. Lippincott Co., Philadelphia, 1945.

seemed significant in 10 instances. These changes included increased tone or irritability in the region of the cecum, ascending colon, descending colon, or sigmoid. Tenderness, present in about half of the patients with irritability, varied in intensity and was not always localized to the irritable portion of the colon. Indeed, tenderness was often present in those colons which appeared normal by barium enema.

Of the 32 patients with amebic dysentery, 7 revealed irritability in the cecum. In 25 (79 per cent), the barium enema examinations were normal even though the patients were passing pus and blood by bowel and revealed ulcers proctoscopically at the time the enemas were given. It is only fair to state, however, that double contrast studies were not obtained routinely. Had this been done significant mucosal changes might have been observed.

It is noteworthy that no difficulty was encountered in filling the terminal ileum in our patients with amebic dysentery.

SUMMARY

1. Rapid small intestinal motility is a common finding in amebiasis.

2. In relatively early amebiasis, cecal irritability is more often demonstrated by the oral barium meal than by barium enema.

3. Asymptomatic cyst passers rarely reveal roentgen evidence of their amebic infestation.

4. Barium enemas in patients with relatively early amebic dysentery often fail to reveal roentgen evidence of the patient's disease.

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BENIGN ULCER OF THE FOURTH PORTION OF THE DUODENUM

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MOST duodenal lesions occur in its first portion and the majority of these are peptic ulcers. Duodenal ulcers are usually seen in the first 2 inches of the duodenum and very rarely in the remaining portions. The duodenum is customarily divided into the superior, descending and inferior portions. The terminal part of this latter portion bends slightly upward and to the left, forming the ascending or fourth portion. Bockus[3] states that peptic ulcer does occur in the fourth part of the duodenum, but reports are distinctly infrequent.[10,11,14]

Diverticula in this area are not uncommon,[1,5,7,13] and there have been many reports of malignant new growths in the fourth portion.[4,6] Primary ulcer of the jejunum has received even more attention.[2,8,9,12]

At present, we consider peptic ulcers as being dependent for their production on the digestive action of gastric juice. However, in considering the pathogenesis of extrabulbar ulcerative lesions of nonspecific origin, we are led to investigate all theories and experimental evidence whether neurogenic, infectious, vascular, chemical or mechanical, because of the unusual site of these lesions.

CASE REPORT

Mrs. A.O., aged sixty-one, white, housewife. The patient was first seen at the age of forty-six when she entered this hospital for a hemorrhoidectomy. At that time she had a negative serology, normal blood sugar, three plus glycosuria and was then three years postmenopausal. There were no gastrointestinal complaints.

A few years later, she had vague gastrointestinal complaints of dyspepsia and belching but no heartburn, pain or melena, and nothing of a serious nature requiring any medical attention.

However, in December, 1937, when she was fifty-four years old, her husband died and three days later she had an episode of hematemesis with syncope, followed by bright bloody and later black stools. She was treated at home and gradually improved and remained relatively symptom-free for one year. She then developed episodes of severe epigastric pain, unrelated to meals, beginning in the epigastrium and extending into the right upper quadrant. There was considerable night pain and belching. The pain was on occasion relieved by ingesting food or alkali but not consistently. These periods of pain lasted two to three weeks and then she would become relatively symptomless for an equal period of time.

In February, 1940, following recurring episodes of this epigastric pain, she underwent cholecystectomy, at another hospital. The gallbladder was normal. Exploration of other abdominal organs was not performed. Following this operation there was no relief of her symptoms.

Later, she was seen in still another hospital as an out-patient and had several admissions. An Old Tuberculin test and chest roentgenogram were negative. Gastroscopy revealed a normal stomach. A gastrointestinal roentgen series in May, 1939, was negative and one done two years later (April, 1941) showed delayed emptying of the transverse duodenum. On each admission the patient was suspected of having a peptic ulcer and was treated with bland diet, antispasmodics and sedatives with relief of her symptoms for a period, although there was no confirmatory evidence of peptic ulcer.

In January, 1943, she was first seen at the Buffalo General Hospital for her gastrointestinal complaints, which consisted of epigastric pain and distress. Also, one week before admission, she had begun to vomit one-half hour after meals. There was no retention emesis and no hematemesis. She had an occasional tarry stool.

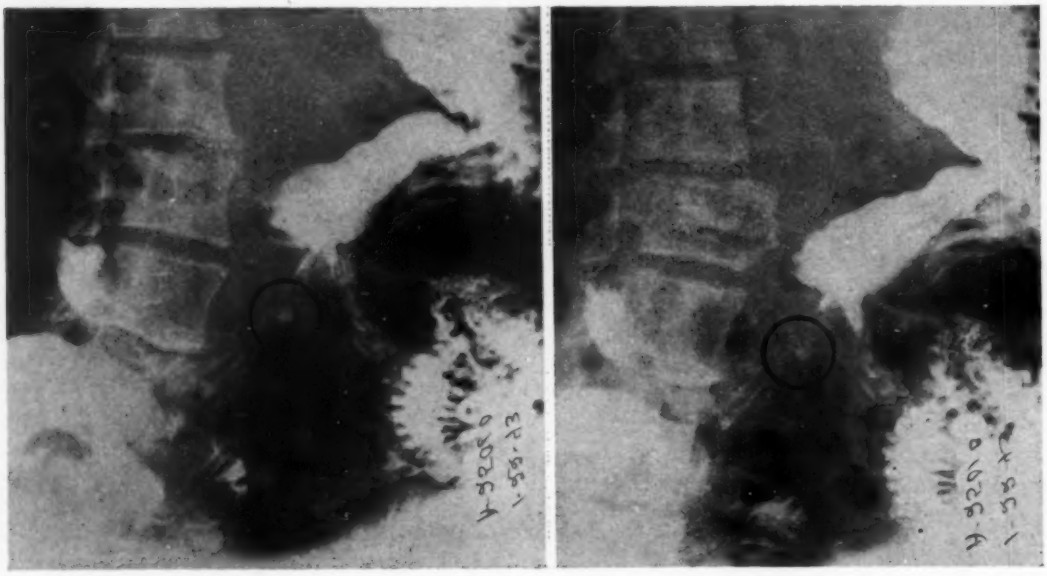

FIG. 1. Left posterior oblique projections taken on January 22, 1943. These show the ulceration and the intact mucosa pulling in toward the area of ulceration.

There had been no unusual weight loss. On examination there were no areas of abdominal tenderness.

FIG. 2. Right anterior oblique projection also taken on January 22, 1943. This demonstrates the crater to be definitely extraluminal. In comparison with Figure 1, it can be seen that there is variation in both caliber and shape of the affected segment of the duodenum.

A gastric analysis with alcohol meal revealed high values for free hydrochloric acid (121 units) and total acidity (126 units). The red blood count was 5 million with a normal hemoglobin complement (14 grams). Sedimentation rate was normal. Repeated stool examinations did not reveal occult blood.

Roentgen Findings (Upper Gastrointestinal Tract): *January 22, 1943*. Pea-sized ulcer crater of the fourth portion of the duodenum with associated spastic narrowing which could be seen to relax under roentgenoscopic observation. The duodenum was dilated proximally. Mucosal markings could be seen converging toward the area of ulceration. There was a slight four hour residue in the stomach.

February 8, 1943. The duodenum again showed the area of narrowing approximately as before. However, the crater could not be well visualized apparently because of the extreme irritability of the bowel.

March 1, 1943. Area of narrowing of the duodenum appeared slightly more extensive; however, there was still variation in caliber from time to time. The crater, which was previously seen, could not be visualized. There was a greater four hour retention.

April 8, 1943. Roentgen findings were the same as on March 1, 1943.

January 19, 1944. Stomach and duodenum appeared entirely normal at this time.

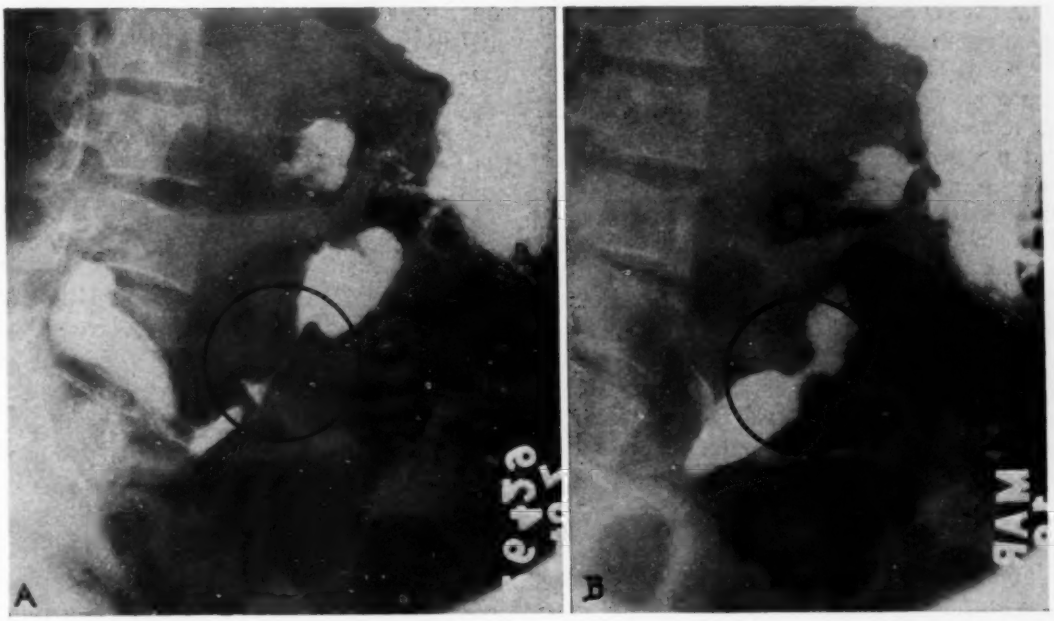

Fig. 3. Left posterior oblique projections taken on March 1, 1943. The crater could not be filled at this time. The variation in caliber and contour of the narrowed segment is well shown.

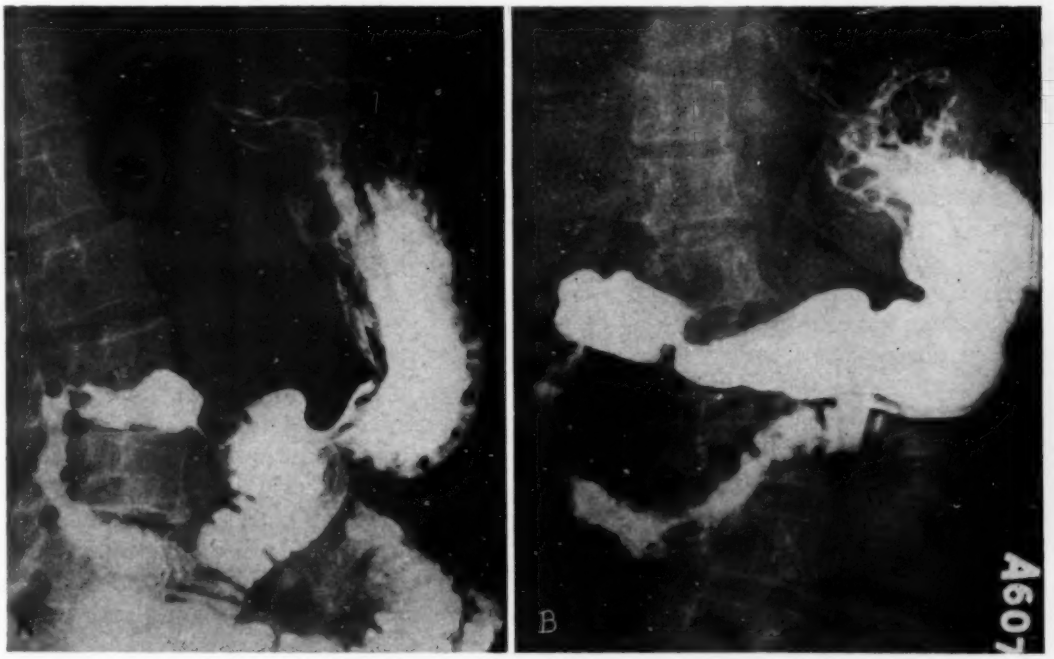

Fig. 4. Follow-up examinations. (*A*) taken November 19, 1944, and (*B*) taken October 18, 1945. Both show the duodenum to be entirely normal.

October 19, 1945. Stomach and duodenum again appeared normal.

Course. During her hospital stay, the patient improved symptomatically under a careful ulcer regimen. However, because of the location and persistence of her gastrointestinal lesion, exploratory laparotomy was advised. She refused operation. Also, during her hospital stay, diabetes mellitus was diagnosed and controlled with protamine zinc insulin. She was discharged on March 8, 1943, to be followed in the out-patient gastrointestinal clinic.

Following discharge, she had a recurrence of symptoms and was treated at home with ulcer diet. She improved rather rapidly and remained symptom-free on a modified ulcer regimen. She has had no return of symptoms.

COMMENT

This case offers an excellent opportunity for comparing percentages with fixed criteria in attempting to arrive at a diagnosis. We are dealing with a lesion in which the only positive findings are determined by roentgen studies. The only clinical data are subjective except for high acid values in the gastric contents. This, then, presents the problem of a known lesion, in which it is necessary to decide whether this lesion is malignant or benign and to do so by roentgen standards.

From statistics alone it can be gathered that malignant lesions of the duodenum are relatively rare; however, they are not nearly so rare as benign ulcerations beyond the first 2 or 3 inches of the duodenum. This is, of course, excluding ulcerations of the upper jejunum, particularly near the attachment of the ligament of Treitz, which have been studied carefully by many observers. It was primarily because of these statistical data that exploration and excision of this lesion was favored by the surgical staff.

The next thought to be commented on is evidence of healing observed commonly in benign lesions as opposed to lack of healing or progress in malignant lesions. Because we had never observed the rate of healing of a benign ulcer in the fourth portion of the duodenum and were unable to find any such data available in the literature, this became a major problem. When, after nearly three months of conservative therapy, it was found that this duodenal lesion was still present, our original contention that this lesion was probably benign, appeared to be less and less valid. As a matter of fact, at that time all were agreed, including the roentgenology department, that surgery should be carried out immediately. It was only the uncooperative attitude of the patient that gave us the privilege of following this lesion through to complete healing.

The greatest lesson derived from this case is the validity of certain roentgen criteria in the differential diagnosis of malignant and benign lesions of the gastrointestinal tract if such criteria are carefully and correctly interpreted. The comments on these standards must be taken as generalizations because these findings can be used with great accuracy in arriving at a differential diagnosis between inflammatory and neoplastic lesions, regardless of location or rarity of such lesions in the gastrointestinal tract. The criteria which apply to this case will be listed and commented on briefly.

1. *Mucosa Surrounding Ulcerations.* Mucosa is recognized by its folds which are produced by the action of the muscularis mucosae. These folds are more or less characteristic for various portions of the gastrointestinal tract. If the mucosa is replaced by neoplasm, these folds will not be recognized. On the other hand, in inflammatory lesions mucosal folds appear normal or are accentuated. The accentuation is probably due to a combination of two mechanisms: (*a*) actual mucosal hypertrophy from inflammatory infiltrates, and (*b*) increase in contraction of the muscularis mucosae from stimulation by the inflammation. This case illustrates very well completely normal mucosal folds up to the area of ulceration.

2. *Distensibility of Wall.* In both inflammatory and neoplastic lesions there may be narrowing of the lumen of the affected organ. In neoplastic lesions the narrowing

is the result of actual infiltration and proliferation of tumor tissue and therefore the caliber of the lumen cannot be expected to change. In inflammatory lesions the narrowing is the result of two processes: (*a*) inflammatory swelling, and (*b*) associated spasm. The amount of spasm varies from time to time, and so with this variation we see changes in caliber of the lumen. This phenomenon was observed on every examination in this case.

3. *Rigidity or Fixation of the Wall.* This is closely allied with criterion number 2. The rigidity of the wall in a neoplasm is the result of invasion of the bowel wall. In a severe inflammatory process marked inflammatory infiltrates may likewise produce rigidity. However, in this case we were able to determine that the bowel wall was not fixed.

4. *Position of Crater in Relation to Lumen of the Organ.* This has been most widely used in the differential diagnosis of malignant and benign lesions of the stomach. However, the same is true of ulcerations in other portions of the gastrointestinal tract. The ulceration in this case was definitely extraluminal.

CONCLUSIONS

1. A case of benign ulcer of the fourth portion of the duodenum has been presented.

2. The diagnostic criteria for benignancy which apply have been discussed briefly.

3. The importance of applying such criteria to all gastrointestinal lesions has been stressed.

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NEPHROGRAPHY*†

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NEPHROGRAPHY designates the roentgenologic contrast visualization of the kidneys.

In acute calculous and non-calculous obstruction of the ureters it may be observed that on intravenous urography the kidney shadow on the side of the blockage will gradually become radiopaque. This phenomenon was first noted by Wesson and Fulmer[7] and later described in more detail by Wilcox[8]. In a recent study of acute renal colic by intravenous urography we found opacification of the kidney in 10 out of 23 patients[2] (Fig. 1). Though the nephrogram[4] (opacified kidney shadow) constitutes an important roentgenologic sign of ureteral obstruction, it has received comparatively little emphasis in the literature and its description is frequently omitted in standard works of urology and radiology.

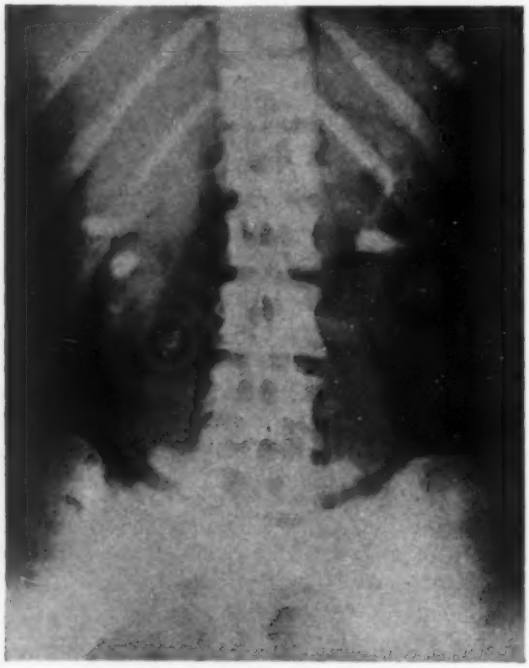

FIG. 1. Acute urinary tract obstruction, right side. Opacification of right kidney parenchyma after intravenous injection of diodrast.

The formation of urine depends largely upon filtration of plasma in the renal glomeruli with subsequent resorption of water and various constituents of the filtrate in the tubules of the kidney. Certain substances, especially those foreign to the body such as dyes and iodides, are to a smaller or larger extent directly eliminated by the tubular epithelium.[6] In the presence of acute ureteral obstruction the intrarenal pressure may attain a level at which glomerular filtration is suppressed. This inhibition of glomerular filtration is apparently not associated with cessation of tubular function. Under these circumstances iodine compounds such as diodrast may be excreted into the renal tubules where the contrast medium will remain, creating a diffuse opacification of the kidney on roentgenologic examination.

These observations suggested the possibility of artificially producing a nephrogram which might prove of value in the study of renal disease. Differentiation of the renal shadow from extrarenal masses on roentgenologic examination may also be facilitated by such a procedure.

A practical method for unilateral ureteral blockage was the chief obstacle. External pressure was generally not effective and cystoscopic introduction of a tapered bougie was tried but proved to be cumbersome and unreliable. An ideal method would be the insertion into the ureter of a small balloon which on distention would produce constant and effective occlusion. In our studies we employed Dourmashkin's dilating bougie[1] which consists of a small

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† Presented in part at the meeting of the Southern Section of the American Federation of Clinical Research in Atlanta, Dec. 8, 1945.

rubber bag attached to a radiopaque ureteral catheter. This rubber bag was introduced into the proximal or mid-ureter where its position was ascertained by roentgenographic examination. The rubber balloon was then gently dilated with 0.5 cc. of mercury. This was frequently accompanied by a very transitory pain in the flank.

Following ureteral obstruction a nephrogram was produced by immediate intravenous injection of 30–35 cc. of 35 per cent diodrast solution. Because some of the contrast medium escaped into the kidney pelvis shortly after ureteral obstruction a simultaneous pyelogram was frequently observed. If the diodrast injection was delayed for ten to twenty minutes only a small amount of the contrast medium or none at all appeared in the kidney pelvis. In any case thirty minutes after intravenous diodrast injection a roentgenogram depicting satisfactory opacification of the kidney shadow was obtained (Fig. 2). Within a few minutes after removal of the rubber bag the kidney shadow returned to normal density and a pyelogram resembling those produced by retrograde methods was observed. The kidney and the kidney pelvis were somewhat enlarged during nephrography but returned rapidly to normal size.

The clinical aspects of this method require careful consideration. The question arises as to whether this method is prohibitively painful to the patient. This problem was studied in a selected group of 8 patients, 6 of whom were believed to have normal urinary tracts and 2 of whom had hydronephrosis. Since a certain degree of discomfort was expected all of our patients received pantopon (gr. ¼) prior to nephrography. Three patients of this group did not experience significant discomfort. In 2 patients the pain was mild, in 1 moderate and in 2 patients marked. The pain experienced by these patients was not considered to be severe enough to prohibit the use of this method if it should prove to be a valuable diagnostic procedure.

It appears important to determine whether the temporary ureteral obstruction has any ill effects on the urinary tracts or on the patient's general condition. Following nephrography urine examinations and selective phenolsulfonephthalein tests were done in all 8 patients. In addition, most of the patients were re-examined at various intervals by intravenous urography. A transient hematuria of not more than one day's duration was observed in 3 cases. This was attributed to instrumentation and possibly congestion above the point of obstruction. We believe that it was probably not greater than that frequently associated with ureteral catheterization. In this group of patients and in others subsequently examined we were not able to detect permanent structural or functional changes of the examined urinary tract. It is well known that ureteral calculi may produce intermittent obstruction without causing permanent pathologic changes of kidneys and ureters. Also, accidental observations are recorded which indicate that the urinary tracts may return to

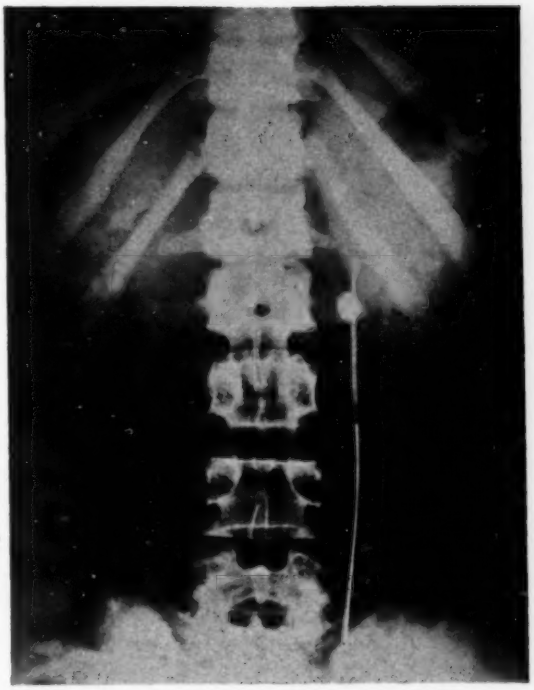

Fig. 2. Nephrogram, left side. Note Dourmashkin bag in left proximal ureter.

FIG. 3. Nephrogram, left side. Left posterior oblique view. Superior and inferior pole of kidney clearly visualized.

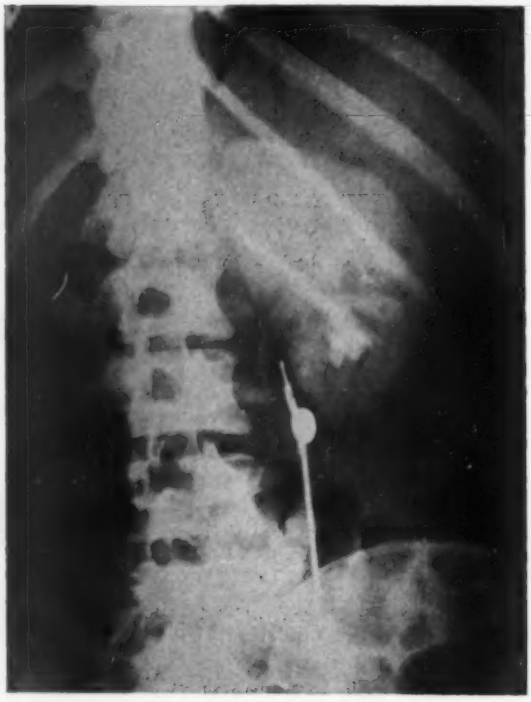

FIG. 4. Nephrogram, left side. Oblique view.

normal size and function after complete ureteral ligation of several days' duration.[5]

The opacified kidney shadow lends itself well to roentgenologic examination in various projections such as oblique views permitting visualization of the entire kidney surface (Fig. 3 and 4). The hilum of the kidney is frequently clearly recognized (Fig. 5). In conjunction with laminagraphy (body section roentgenography) satisfactory roentgenograms of the kidney in the lateral view were obtained.

FIG. 5. Nephrogram, left side. Renal hilum clearly visualized.

Nephrography makes it possible to demonstrate the excretory portion of the kidney. Lesions which displace the parenchyma may be revealed as defects in the opacified kidney shadow. For these reasons this method should be valuable in the demonstration of tumors, cysts, abscesses and infarcts. Thus, Hellmer,[3] studying patients with acute renal colic by intravenous urography, was able to recognize a cyst and a tumor as defects in the opacified kidney shadow. He described as nephrog-

raphy the opacification of the kidney following intravenous urography in patients with renal colic. We would like to see this term accepted not only for the spontaneous phenomenon but for the artificial diagnostic procedure.

By means of nephrography certain congenital anomalies such as horseshoe kidneys and ectopic kidneys may be studied to advantage. In complete reduplication of the urinary tracts the line of cleavage can be satisfactorily outlined. Finally, the kidney may be differentiated without difficulty from extrarenal masses. This appears to be of particular value in those cases in which roentgenographic visualization of the kidney shadows is difficult because of overlying soft tissues or gas shadows, or due to lack of cooperation of the patient.

Nephrography should not be a routine procedure nor should it replace pyelography, the value of which is firmly established. Pyelographic findings are, however, occasionally equivocal. There are cases of renal tumors and abscesses in which pyelography will fail to yield positive information, making other diagnostic procedures desirable. In these cases nephrography may prove to be a valuable adjunct to the roentgenologic methods now employed and may contribute to earlier and more accurate diagnosis of renal disease.

SUMMARY

1. In acute urinary tract obstruction, opacification of the kidney shadow occurs on intravenous pyelography. The physiologic principles of this phenomenon are considered.

2. A procedure which permits temporary artificial urinary obstruction is described. By this method contrast visualization of the renal parenchyma may be obtained (nephrography).

3. Certain diagnostic possibilities of this method in the roentgenologic examination of renal and perirenal disease are briefly discussed.

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MASSIVE CONGENITAL HYDRONEPHROSIS

A CASE REPORT

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A WHITE soldier, aged twenty, received a blow to the left lumbar region when his plane made a crash landing. Although there was no ecchymosis of the skin or swelling over the lumbar region, he suffered severe pain in the left kidney area and his urine became grossly bloody. He continued to have pain in the left kidney area for one week and his urine remained grossly bloody for ten days. At the end of two weeks he was transferred to another hospital with a diagnosis of laceration of the left kidney.

Physical examination at the second hospital was of no particular significance except for a palpable mass in the left upper quadrant of the abdomen. His urine by this time was grossly normal in appearance but urinalysis still showed microscopic blood.

An intravenous urogram was made four weeks after the accident. This showed the right side of the urinary tract to be normal in appearance, but the left kidney was not definitely visualized and there was a vague suggestion of several poorly defined, soft tissue masses on the left side of the abdomen. The margin of each psoas muscle was sharply visualized on the urograms.

The intravenous urogram was followed in one week by a retrograde pyelogram on the left side. Preliminary roentgenograms at this time again showed the vaguely outlined masses on the left side of the abdomen. These masses were very shortly found to represent markedly dilated calices of the left kidney. Approximately 150 cc. of diodrast was injected into the left kidney for the pyelographic study and an enormous dilatation of the pelvis and calices was found, the ureter being deviated toward the right side by the hydronephrotic mass (Fig. 1). Two days later another roentgenogram of the abdomen was made with a catheter in the left ureter. This roentgenogram demonstrated that the left ureter was not only displaced to the right by the enlarged kidney but that it entered the kidney pelvis from above (Fig. 2). It also showed considerable retention of diodrast in the kidney from the injection two days before.

A left nephrectomy was performed by one of us (E.A.O.) two days after the retrograde pyelogram and thirty-nine days after the accident, and a large hydronephrotic sac containing only a small amount of remaining kidney parenchyma was removed. The hydronephrosis was of the type thought to be due to obstruction secondary to an aberrant high ureteral insertion into the kidney pelvis with possible associated aberrant band or vessel at the ureteropelvic junction. Convalsecence was uneventful and the patient was discharged to duty ninety-seven days after the accident.

This case is of interest not only because of the unusually large hydronephrosis but because the patient had had no symptoms referable to the urinary tract prior to the accident. The pathological condition in the left kidney was not discovered when the patient was inducted into the Army, and he had been able to lead the usual active life of a soldier for a year or two.

The term massive or giant hydronephrosis is restricted to those cases in which the hydronephrotic sac contains at least 1,000 cc. of fluid. Such cases are comparatively rare, no more than 100 having been reported in the literature. Most of these pathological kidneys are discovered in children or young adults and most of them are probably congenital in origin. Symptoms are not infrequently absent and the predominant clinical finding may be a large abdominal mass. Due to absence of symptoms and the large size of the mass, an erroneous diagnosis may be made when the mass is first palpated. Trauma often directs attention to the pathological kidney for the first time, and if sufficiently severe it may result in rupture of the hydronephrotic sac.

While it is generally believed that high insertion of the ureter is the cause of massive hydronephrosis in many instances, it is

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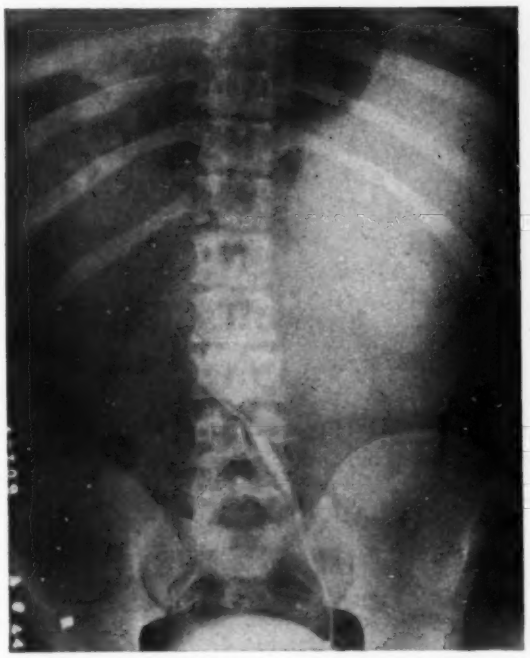

Fig. 1.

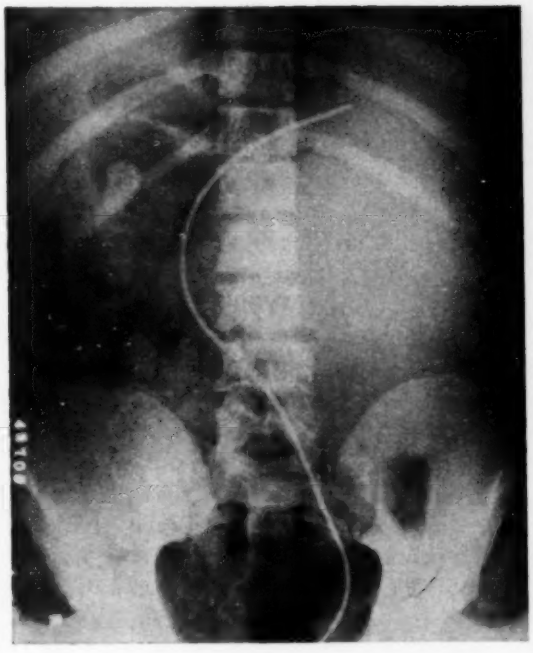

Fig. 2.

not unlikely that the elevation of the ureteropelvic junction may be the result rather than the cause of the pelvic dilatation. Valve formation at the ureteropelvic junction may also be the result of the gradual dilatation of a hydronephrotic sac rather than the cause of the dilatation. This likewise may be true of an anomalous vessel at the ureteropelvic junction, the anomalous course of the blood vessel possibly being the result rather than the cause of the hydronephrosis.

The development of giant hydronephrosis is dependent on the presence of at least some remaining kidney parenchyma to excrete urine, even though small in amount. It is only in those cases of congenital hydronephrosis where infection fails to occur for a long period of time that massive hydronephrosis develops, since infection early in the development of the hydronephrosis leads either to discovery of the abnormality or to changes in the renal substance and walls of the renal pelvis which prevent further expansion of the sac.

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THE SIGNIFICANCE OF THE RETRACTED AND CURVED HORIZONTAL FISSURE OF THE LUNGS*

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PNEUMOTHORAX is the most commonly used measure in the collapse therapy program of pulmonary tuberculosis. Clinicians have, over a period of years, attempted to predict the existence of a free pleural space from roentgen findings—such as the appearance of pleural thickening, lack of retraction of the cardiac, or other mediastinal shadows, and the obliteration of the costophrenic sulcus—and occasionally by physical examination. Each of these methods has been unsuccessful in prognosticating the existence of a free space, and tuberculosis clinicians have, for the most part, arrived at the point in instituting therapy where they are certain of the presence or absence of a free pleural space only after they have attempted to establish a pneumothorax. Any additional sign which could be shown to be of value in predicting a free pleural space would have considerable significance in that much time could be saved the patient as well as useless attempts at offering such therapy. In some cases, surgical collapse measures with thoracoplasty could be instituted as a primary procedure if one could definitely say that either no space would be available or that the best space available would result in a contraselective collapse.

In the course of treatment of pulmonary tuberculosis it has been observed that in many instances where the disease was confined to the right upper lobe, this area was widely adherent when pneumothorax was instituted. In many such instances it was further observed that the horizontal fissure assumed a characteristic curvilinear appearance upwards. An attempt was then made to find the significance of this observation by checking with additional cases prior to the institution of pneumothorax. The problem was, on the one hand, to determine whether there was a consistent relationship between the curved horizontal fissure and an adherent upper lobe; and, on the other hand, to explain such an anatomical appearance.

It is rather obvious that it is only in such cases as the fissure can be outlined on the roentgenogram that such a change becomes useful. It would appear that the horizontal fissure is not present in all cases, and this has been thoroughly studied in anatomical and surgical experiments.

Brock,[2] in a study intended to show that the standard descriptions of fissures were slightly misleading, reviewed some of the literature, and by the use of metal markers delineated the fissure of the lungs. He noted that the horizontal fissure was often absent or incomplete and quote Hovelacque's figures[3] to the effect that the fissure was complete in 29 per cent of the cases, absent in 20 per cent, and partial in 51 per cent. Kent and Blades,[4] in a follow-up study resulting from their elaboration of the individual ligation technique for lobectomy, dissected 227 lungs immediately after death, studied embalmed cadavers, and applying their knowledge derived from lobectomies, came to the conclusion that a complete fissure does not exist in the human being. However, for statistical purposes they considered a slight degree of union close to the hilum as a complete fissure. They found the fissure between the right middle and upper lobes was absent in 21 per cent of the specimens and incomplete in 67 per cent.

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It would appear, then, that in one-fifth of all cases the fissure can never become more than partially visible. The fissure may be observed on the roentgenogram when present physiologically and also under certain pathological conditions.

In the usual posteroanterior roentgenograms the pleural membranes are not ordinarily seen. At each fissure line the approximation of two such surfaces may become apparent if a considerable number of the beams coming from the tube pass directly through the plane of the fissure. The fissure is then seen as a fine line across the lung field. Such visualization does not necessarily mean that there has been pleural thickening.[1,8]

From a pathological point of view, both the horizontal and the long oblique fissures are involved by the same processes which attack the general pleural space. Thus, inflammatory processes, malignancies, and other conditions which may involve the free pleura, may also involve the fissures, and, with the resultant fibrosis, make such fissures visible on roentgenograms.

With the appearance of a tuberculous process in any part of either lung which does not go on to more or less complete resolution, certain associated changes almost invariably take place. The loss of inherent elasticity present in pulmonary tissue, the production of secondary fibrosis and emphysema, and the associated involvement of the bronchial tree, all produce a tendency to shrinkage of the pulmonary parenchyma. Such a retraction of lung tissue usually takes place towards the hilum in a manner well described by Macklin,[5] Pinner,[6] and Robbins and Hale.[7] They visualize the process as being that of a closing of a fan, as well as shrinkage from the periphery inwards.

Inasmuch as adhesive pleuritis is a common concomitant of the tuberculous process, such shrinkage will, of necessity, occur in irregular fashion in such instances. As the upper lobe is adherent throughout the greater portion of its pleural space, shrinkage can occur only towards its center from the free portion, i.e. the lowest portion facing the horizontal fissure. Since one of the features of adhesive pleuritis is a fixation of the hilar structures or, at best, a movement in a cephalad direction, and since the peripheral portion of the lung has become adherent by the same process, the horizontal fissure becomes drawn up in the form of a bow-string. The appearance may be compared with that of the sucking up of the rubber base in vacuum experiments with a bell jar (Fig. 1).

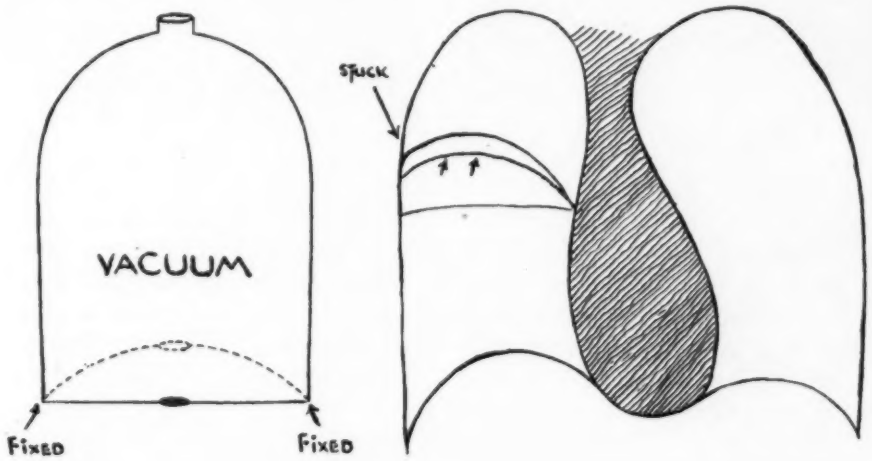

Fig. 1.

A number of respresentative cases are included, with roentgenograms before and

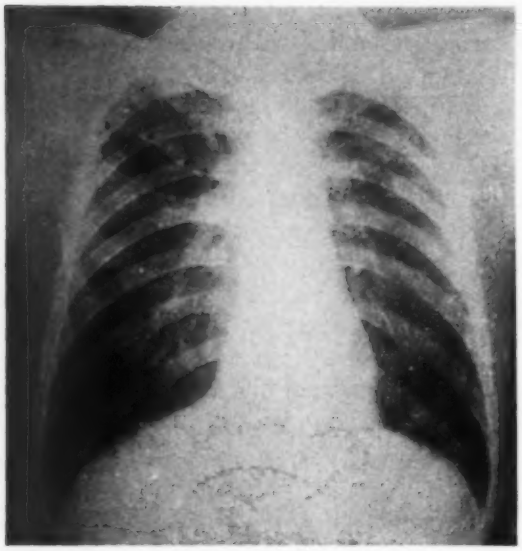

Fig. 2. Case 1.

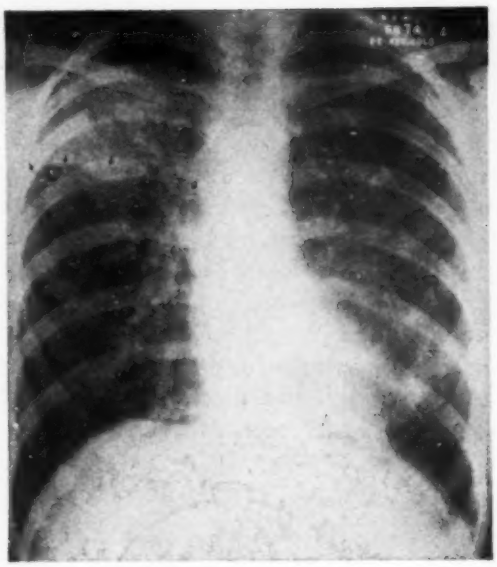

Fig. 4. Case II.

after pneumothorax. In each case the horizontal fissure was visibly bowed roentgenologically before pneumothorax was attempted. In Case 1 (Fig. 2) the roentgenogram showed an extensive exudative fibrotic infiltration in the right apex and first costal interspace. The left side was involved also, from the apex down to the second interspace. The hilar and bronchial markings were prominent—and elevated. After a trial of bed rest, right pneumothorax was attempted. While a space was found, the pneumothorax was contraselective (Fig. 3). Nearly the whole of the upper lobe was adherent to the chest wall.

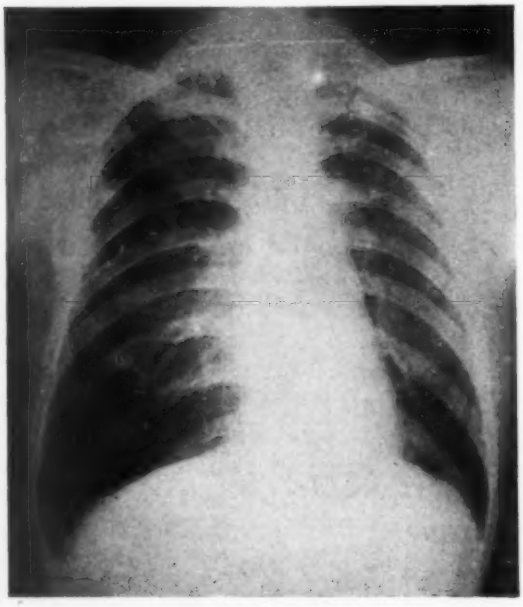

Fig. 3. Case II.

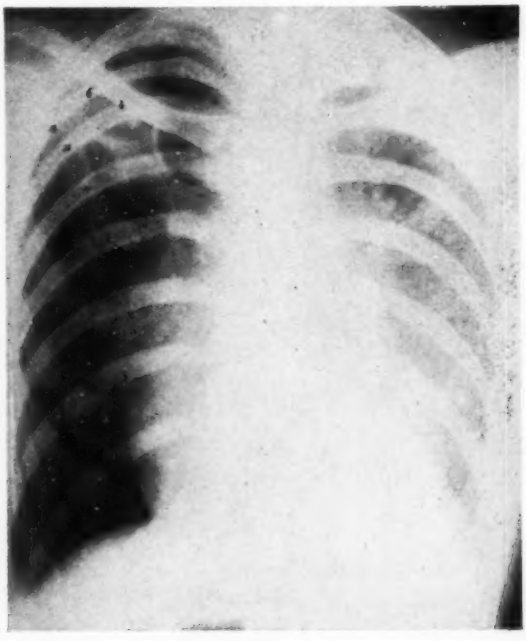

Fig. 5. Case II.

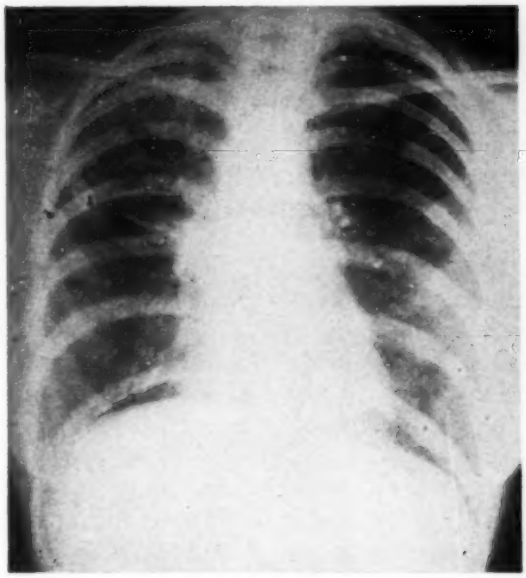

Fig. 6. Case III.

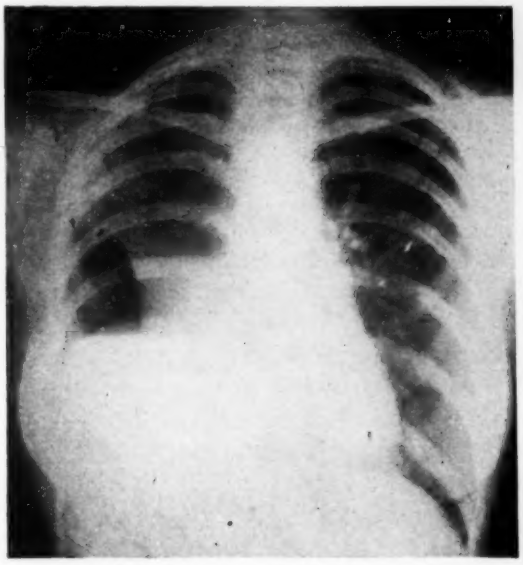

Fig. 7. Case III.

In Case II the patient had had a left-sided pneumothorax but it had spread to the contralateral side. The roentgenogram revealed an exudative productive infiltration of the right upper lobe (Fig. 4). The infiltration extended to the limits of the lobe and made the horizontal fissure visible. It was retracted and curved, with the convexity upwards. The left side was allowed to re-expand and right-sided pneumothorax induced. A widespread, thick adhesion was visualized (Fig. 5), preventing selective collapse.

In the third case presented there was a history of an acute onset. The roentgenogram (Fig. 6) revealed an extensive exudative infiltration from the apex down to the right third anterior rib. There was an annular shadow about the size of a silver dollar at the level of the first rib and interspace anteriorly. The right hilum was not elevated but was much more prominent than usual. The horizontal fissure was visualized in a gentle curve, swinging out from it. At the chest wall the fissure took a sudden sharp curve downward. The left hilum had several well calcified lymph nodes. The parenchyma appeared free of disease. Right pneumothorax was induced shortly after admission. The roentgenogram (Fig. 7) revealed a broad band adhesion from the level of the third to the first rib anteriorly. Fluid formed fairly early.

SUMMARY

1. An explanation is offered for the curved appearance of the horizontal fissure of the lungs.

2. Its appearance as related to the ability to predict an adequate pneumothorax is discussed.

3. Illustrative cases are presented.*

I wish to express thanks to Mr. A. Wainhouse and Miss Jeanette Haber for technical assistance.

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* Since this article was written attention has been called to two articles from widely divergent sources dealing with this subject. They are: Roentgenological signs of adhesive pleuritis, by J. L. Wilson, *Yale J. Biol. & Med.*, 1943, *15*, 489–493, and The position of the transverse interlobar fissure of the lung in relation to prognosis in pulmonary tuberculosis, by B. H. Y. T'ang and C. L. Hsü, *Tubercle*, 1940, *21*, 249–259.

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Vol. 57, No. 3

FRACTURES OF THE RIBS

WITH COMPARISON OF THE STANDARD AND THE ONE-FILM TWO-EXPOSURE TECHNIQUE*

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THE roentgen diagnosis of fracture of the rib immediately following a chest injury is satisfactory indeed when a fracture is found but is doubtful and inconclusive when no fracture line is seen. Numerous times in the past, we, as well as other radiologists, have been greatly disappointed by roentgen examinations of the ribs which failed to show fracture, and a few weeks later re-examination elsewhere, or even in our own offices showed one or more fractures, which could not be identified in the original roentgenograms even after knowing their exact location. Parker[1] sums the situation up when he states that "X-ray usually reveals the fractures, but not infrequently radiographic evidence is lacking, and if confirmation is necessary, other projections at various angles should be made."

This inadequacy of the roentgen ray to diagnose rib fracture is well illustrated in our own studies of 4,029 cases.† In 100 cases of recent chest injury suspected clinically of rib fracture and in which roentgen examination was negative, re-examination three weeks later disclosed fractured ribs in 22 cases; the other 78 remained negative roentgenologically.

In another 100 cases with fracture of one or more ribs, re-examination three to six weeks later disclosed one more fractured rib in 32 patients, two more in 9 cases, and three more in 1 case. On the other hand, in 6 cases with single rib fracture, the fracture could no longer be identified; and in 9 cases with multiple fractures, re-examination disclosed one less fractured rib. Since in these cases the re-examination from three to six weeks later failed to show one fractured rib, although the location could be identified by the previous examination, it is evident that at least 15 per cent of rib fractures heal without periosteal callus so satisfactorily that they can no longer be identified. This may account for the fact that a number of cases with fracture of the ribs are undiagnosed by roentgen examination immediately after the injury, and, healing completely without periosteal callus, are negative even weeks or months after injury.

Some other reasons for the difficulty of finding fractures of the ribs immediately after injury are that the ribs are relatively small structures compared with the mass of tissues radiated, especially in the lower ribs. Only one-third of the rib can be brought close to the film on any single exposure; the other two-thirds are in different planes, parts are almost in the same axis as the central ray, or are away from the film. Because of the markedly different densities of the chest structure, the upper ribs tend to register much darker than the lower ribs, which show slight contrast to the heavy muscular tissues surrounding them. Last but not least, unless the injury is severe the fragments are neither separated nor ragged immediately after the injury, but within a period of three to six weeks the fragments either separate, the edges become ragged, or callus is formed, exposing the presence of fracture. These considerations have led us to enforce a strict rule in our clinic—that, if the clini-

* Approved for publication by the Surgeon General, U. S. Public Health Service.

† Our material is from the United States Public Health Service Clinic in New York City. The patients were all ambulatory and suffering from chest injuries. Over 98 per cent were males; 42 per cent were WPA workers, 33 per cent merchant seamen, 8 per cent longshoremen, 16 per cent E.C.C. cases referred essentially for decision on period of disability, and only 1 per cent were sent to us for treatment only.

FIG. 1. The fracture of the eighth and ninth ribs can be easily identified on the anteroposterior continuous respiration view and cannot be identified on the posteroanterior suspended respiration view—an exception to prove the rule that if the fracture is seen in one view it can be identified in the other.

cian diagnoses rib fracture, even when the roentgenogram is negative, the patient is treated on clinical findings and re-examined three to six weeks after the injury. A good percentage of fractures which did not show previously will show then.

Our first effort in obviating some of the difficulties encountered in the diagnosis of fractures of the ribs was to have the physician who ordered the roentgen examination designate exactly which ribs were probably involved. The technician was instructed to use two different exposure techniques: for the upper ribs, including the ninth, the exposure was the same as for chests on the Potter-Bucky grid; for the lower three ribs, the exposure was the same as for the kidneys. This arrangement continued through the year 1936 and part of 1937, and resulted in fewer diagnostic failures. Towards the end of 1937, there were again more cases missed, mainly because the clinician was not so careful about designating the ribs in question, so we returned to our old one-exposure technique in the anteroposterior view on a 14 by 17 inch film until the latter part of 1939.

About the same time as Bloom[2] published his continuous respiration technique of taking rib fractures, we established a single-film two-exposure technique of our own which appreciably raised the percentage of correct diagnoses. The first exposure is the usual anteroposterior view. The patient is placed on his back over the Potter-Bucky diaphragm table, which has three lines, one median, the other two 3 inches on each side of the midline, and is shifted so that the side of the chest to be roentgenographed is centered on the midline of the table. We place a right angle on the lateral ruled line of the table, and have the involved side of the chest just touching the vertical bar of the right angle at about the ninth rib. The patient is strapped with a compression bladder and told to breath naturally, preferably with the diaphragm. The exposure is a slow one, using only 10 ma. The peak kilovoltage is proportional to the thickness of the patient, and is usually the same as for the kidneys, with about the same milliampere-seconds.* As a rule six to eight seconds is enough to blot out the vascular and bronchial shadows of the lung if the patient is breathing during the exposure. A 14 by 17 inch film is placed in the Potter-Bucky tray with half its surface covered by a 17 by 7 inch strip of lead, and the uncovered part is centered in the midline of the tray. The exposure is made either during inspiration or expiration. The film is then shifted so that the unexposed part is now centered over the middle of the tray,† and the lead is placed over the exposed half of the film. The patient is now asked to lie on his abdomen so that the side of the chest to be roentgenographed again lies equally on both sides of the center of the Potter-Bucky

* The radius of our Potter-Bucky diaphragms is 40 inches, and our target film distance is 40 inches.

† If the tray does not accommodate the shift of the cassette, the cassette is turned 180 degrees and the patient is turned around so that the head and feet exchange positions.

table. Again the right angle is used on the other lateral line with the patient so placed that his ninth rib touches the vertical bar during sustained deep inspiration. The peak kilovoltage is the same as on the previous exposure, and so is the milliampere-seconds, but the exposure is as short as the tube and Potter-Bucky diaphragm will permit, since it is done while the patient takes a deep breath and holds it.

If each half of the film has been placed only one-half of the 14 by 17 inch film is exposed in each view, a lead cut-out or a rectangular cone to cover only that area with a small margin is used. This diminishes the secondary radiation and results in sharper outline of the ribs both in front and back. (5) The proper arrangement of the two views so that the axillary region is towards the middle of the film permits speedy viewing of each rib on either side of the midline, and results in greater accuracy in diagnosis, since the majority of fractures (79.1 per cent in our series) are in the axilla.

TABLE I

NUMBER OF PATIENTS POSITIVE AND NEGATIVE FOR RIB FRACTURE IN EACH YEAR AND THE PERCENTAGE

Year	Negative		Total Negative	Positive		Total Positive	Patients		Total Patients	Percentage Positive	
	Right	Left		Right	Left		Right	Left			
1936	209	213	422	58	62	120	267	275	542	22.13	
1937	240	281	521	62	82	144	302	363	665	21.65	
1938	308	377	685	66	88	154	374	465	839	18.36	
1939	254	307	561	57	87	144	311	394	705	20.4	
											20.07%
1940	233	302	535	78	86	164	311	388	699	23.46	
1941	211	239	450	60	69	129	271	308	579	22.28	
											22.92%
TOTAL	1455	1719	3174	381	474	855	1836	2193	4029	21.22	

The advantages of this technique are: (1) Two exposures are obtained at almost the same cost as one, giving two different angles, and increasing the percentage of correct diagnoses. (2) Since one exposure is during respiration, the interfering shadows of the pulmonary vessels and bronchi are obliterated by movement of these structures during the long exposure. This gives a clearer outline of the posterior parts of the ribs as well as the axillary parts. (3) The suspended breathing posteroanterior view gives a better outline of the anterior and the axillary parts of the ribs. (4) Since

In reviewing our series of rib fractures to determine objectively the usefulness of the one-film two-exposure technique, we find that in a period of six years (see Table 1) out of a total of 4,029 examinations of chest injuries, 855 were positive for rib fractures, with a total number of 2,014 fractured ribs. There were single rib fractures in only 391 cases; the other 464 cases had 1,623 fractures, i.e., $3\frac{1}{2}$ fractures per patient. Findlay[3] found $3\frac{1}{3}$ per patient. The majority of cases were in the fourth and fifth decades; up to thirty years, 2 per cent; from thirty to forty, 16 per cent; from forty to fifty, 36 per cent; from fifty to sixty, 35 per cent; and from 60 on, 11 per cent. Less than one-third of the patients came to us within forty-eight hours of the injury; some fully

a year after injury.

Of the 3,174 negative cases, 1,719 were of injuries of the left side (54.38 per cent) and 1,455 were of the right side (45.62 per cent). Apparently the left side is more frequently injured in these ambulatory cases. Likewise, of the 855 positive cases, 474 were on the left (55.44 per cent), and 381 on the right (44.56 per cent). Hinton and Steiner[4] also reported 393 fractures on the right and 414 on the left.

Which ribs are more often involved can be seen in Table II and Graph 1. The ninth rib is fractured more often than any other, either alone or in combination with other ribs. The tenth rib is next in frequency, either alone or in combination. Third in frequency, in combination with others, is the eighth rib; and singly is the eleventh rib. These three ribs (eighth, ninth and tenth) constitute more than 50 per cent of all fractures. The frequency diminishes as the upper ribs are approached. The first rib was found fractured only three times in 2,014 fractures, the second only twenty times.

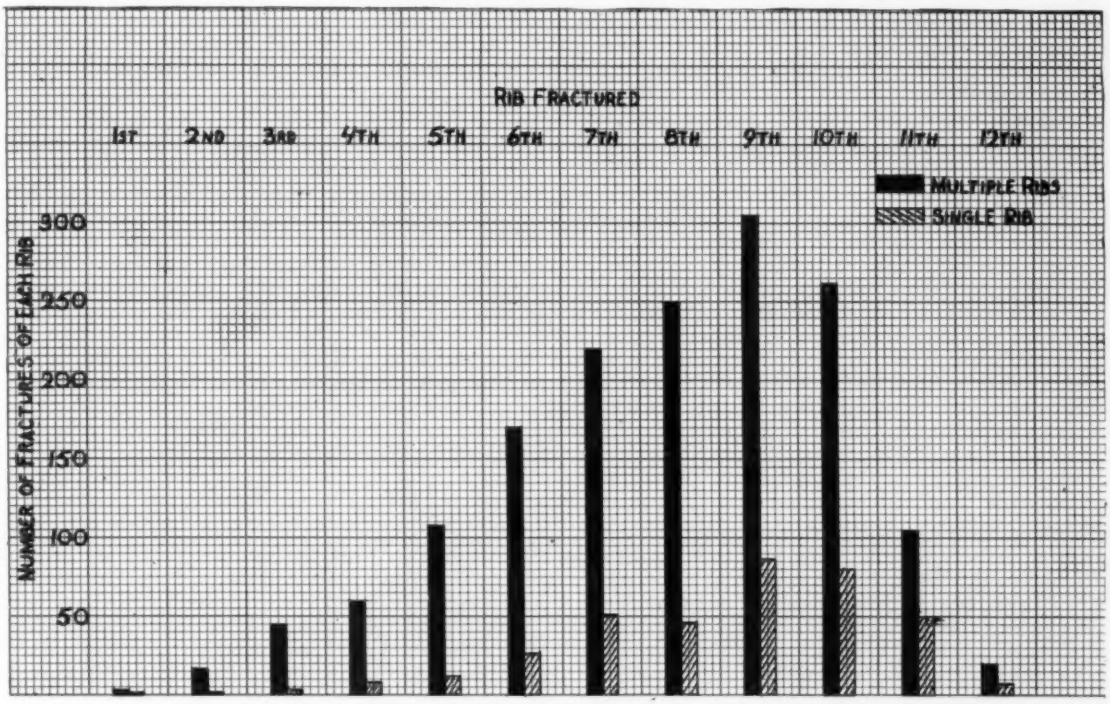
The location of fractures in individual ribs is seen in Table III. We have divided the region, from the roentgenographic point of view, into six subdivisions: *paravertebral*, extending from the vertebral articulation of the rib to 2 inches from the vertebra; *scapular*, 2 to 4 inches from the vertebral column; *posterior axillary*, 4 inches up to the sharp angle in the axilla; *mid-axillary*, from the sharp angle of the

TABLE II

FREQUENCY OF FRACTURES IN INDIVIDUAL RIBS

		1st Rib	2nd Rib	3rd Rib	4th Rib	5th Rib	6th Rib	7th Rib	8th Rib	9th Rib	10th Rib	11th Rib	12th Rib
1936	Combined*			5	14	18	24	35	32	53	46	14	6
	Single				1	1	4	9	5	14	13	4	5
1937	Combined		2	4	11	21	34	40	39	59	49	29	1
	Single			1		1	3	4	9	14	15	10	
1938	Combined	1	5	4	5	16	27	46	52	61	56	28	7
	Single	1	3			5	5	14	13	13	11	8	2
1939	Combined		3	10	9	16	33	32	50	63	59	29	8
	Single				2	3	6	4	6	12	16	8	1
1940	Combined	2	8	12	16	27	37	59	57	75	62	28	1
	Single				7	4	6	8	6	12	11	8	
1941	Combined		4	14	19	27	48	62	74	86	73	31	4
	Single			1		3	6	12	10	23	12	15	1
TOTAL	Combined	3	22	49	74	125	203	274	304	397	345	159	27
	Single	1	3	2	10	17	30	51	49	88	78	53	9

* Combined multiple rib and single rib fractures.



Graph I. Graph of Table II.

rib posteriorly to the sharp angle of the rib anteriorly; *anterior axillary*, the anterior angle of the rib forward for about 2 inches; and *mid-clavicular*, from this region to the cartilaginous border. Table III shows that the three axillary regions taken together constitute 79.1 per cent of all rib fractures. The greatest number in any single region is in the posterior axillary, and the smallest number in the clavicular region. These findings necessitate the focusing of our attention on obtaining the sharpest outline of the rib in the axilla, especially the posterior axillary region.

The findings thus far enumerated are only by-products of our rib fracture review.

Table III

Number of Fractures by Location

	Paravertebral	Scapular	Posterior Axillary	Mid-axillary	Anterior Axillary	Mid-clavicular	Undetermined	Total Number of Fractures
1936	19	32	98	68	29	1	0	247
1937	25	45	109	74	30	2	2	287
1938	16	33	118	100	28	9	4	308
1939	20	21	118	80	70	5	4	318
1940	26	43	155	61	84	5	8	382
1941	18	40	158	112	93	37	14	472
Totals	124	214	756	495	334	59	32	2,014
Percentage	6%	10%	37%	25%	17%	3%	1½%	

The important fact that study of the tables (especially Table II) shows is that in the four years before the one-film two-exposure technique was instituted the percentage of chest injury cases reported positive for rib fracture was 20.07, whereas in the two years after introducing this technique, the percentage of positive diagnoses rose to 22.92. Although this increase is less than 3 per cent of all chest injuries roentgenographed, it represents more than a 10 per cent increase in the number of rib fractures diagnosed. Unfortunately, this statistical comparison could not be continued beyond 1941 because of change in the referring clinician in 1942. We cannot help but state, however, that the improvement in our ability to diagnose rib fractures roentgenographically has been continuous since we instituted the one-film two-exposure technique, and that even lately, when the technicians were in a hurry and took only one view, we missed a good number of fractures which were identified on the one-film two-exposure examinations made a few days later. This recent reminder of the usefulness of the technique, more than any other single fact, prompted us to report our findings at this time—more than six years after the established use of the technique at the U. S. Marine Hospitals in Manhattan, Ellis Island and Staten Island, New York.

SUMMARY

A review of 4,029 cases of chest injuries with suspected rib fractures over a period of six years disclosed 855 cases with single or multiple rib fractures. The one-film two-exposure technique is described to facilitate the identification of the fractures. Using the usual technique 20.07 per cent were positive for rib fracture; and with the new technique, 22.92. Injuries to the left side of the chest are more frequent than the right; and fractures of the ribs are also more frequent on the left in about the same proportion.*

I wish to express my gratitude to Mrs. B. J. Harris, Mr. W. P. Conklin and Mr. H. Vozick for their untiring labors and cooperation.

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* Since this paper was submitted for publication, a paper by R. W. Lewis has appeared in the *New York State J. Med.*, 1945, *45*, 1767, on the subject of rib fractures with similar findings.

Vol. 57, No. 3

AVASCULARIZATION OF THE ASTRAGALUS

By LIEUTENANT COLONEL D. C. WEIR
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THE phenomenon of avascularization of bone segments, following trauma, has been observed since the advent of the roentgen ray, but fortunately it is uncommon. The most frequent location of this condition is at the site of the so-called "terminal blood supply" or in such areas as the femoral head, carpal navicular, or astragalus where, in varying degrees, certain segments are dependent upon one source of nutrition.

The astragalus consists of a body, neck and head. The body articulates with the tibia superiorly, the fibula laterally, and the os calcis inferiorly. The head articulates with the navicular and the os calcis. The neck comprises the constricted portion of the bone between the body and head.[1] The bone receives its blood supply from a branch of the dorsalis pedis artery which enters the lateral aspect of the neck, and a few small branches entering at the ligamentous and capsular attachments.[2]

Fractures of the astragalus are rare, but when they do occur, the most likely location is through the neck, for this site is least sturdy, and a shearing force will tend to break the neck transversely. If the fracture occurs proximal to the nutritional source of the dorsalis pedis artery, the blood supply will be impeded, and the possibility of avascularity of the proximal fragment must be considered.

Hyperemia[3] of the bones and soft tissue occurs following a fracture, and this produces a generalized decalcification and osteoporosis of all the bony structures in the region of the fracture site. The decalcification is dependent upon an intact blood supply to the bones. If the supply is impaired, then decalcification will take place only in those parts adequately nourished, and not in the avascular portion. This circulatory impairment of bone produces a typical roentgenogram with the avascular segment retaining its normal density, while the surrounding bones become osteoporotic.

The following case report is presented to demonstrate the roentgenographic evidence of avascularity of the astragalus subsequent to a fracture through the neck.

CASE REPORT

An Allied soldier, aged twenty-seven, was transferred to our institution with a fracture through the neck of the astragalus following an airplane accident. The transfer roentgenograms (Fig. 1) revealed a transverse, complete fracture through the base of the astragalar neck, with 90° inferior rotation of the proximal fragment. The fractured surface of the proximal fragment pointed toward the os calcis. Closed reduction, under general anesthesia, had been attempted without success; therefore, an open reduction had been performed forty-eight hours later with fixation of the fragments by two screws: one on the medial, and the other on the lateral aspect of the fracture site. Good anatomical approximation of the fragments was obtained.

FIG. 1. Roentgenogram showing fracture through the neck of the astragalus with 90° rotation of proximal fragment.

Subsequent roentgenograms (Fig. 2) made

FIG. 2. Roentgenogram made fifty-five days later revealing the marked contrast between normal density avascular fragment and the pronounced decalcification of the surrounding bones with intact blood supply.

in this hospital fifty-five days later revealed the fragments to be held in good anatomical alignment, and in approximation by two screws, but there was no evidence of new bone formation. There was a generalized decalcification of the distal fragment and the surrounding bones, but a normal density of the proximal fragment. This was interpreted as an indication of avascularity of the proximal fragment. The patient was transferred to an Allied hospital approximately four weeks later. During the period of hospitalization, the foot was immobilized by a plaster cast. Roentgen findings prior to the patient's departure were unchanged.

Comment. This is a typical case of fracture through the neck of the astragalus, proximal to the nutrient dorsalis pedis artery with resultant avascularity of the proximal fragment. The roentgenograms reveal the marked contrast between the normal density of the avascular fragment, and the pronounced decalcification of the surrounding bones with intact blood supply.

The roentgenograms made three months following the injury still revealed calcium retention in the proximal bone fragment with no evidence of revascularization or new bone formation. The end result of the case is unknown. Although revascularization is still possible after a period of three months, it is quite improbable.

SUMMARY

A case of fracture through the neck of the astragalus with subsequent avascularity of the proximal fragment is presented.

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DOUBLE UTERUS

REPORT OF A CASE

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THE patient, Mrs. S., aged twenty-five, has had regular menstrual periods, lasting about three days in a twenty-eight day cycle, ever since the onset of menses, except during pregnancy. She has had two spontaneous abortions; the first in October, 1943, approximately eight weeks after gestation, and the second in July, 1944, after approximately ten weeks. These are the only two pregnancies.

She was examined clinically at one of the nearby military posts by Captain S. Adler who in civilian life is a gynecologist. He referred her to me with a clinical diagnosis of "double uterus."

Vaginally, she presented a double cervix; each appeared approximately normal in shape, but each a trifle smaller than the average normal. There was no endocervicitis or leukorrhea. There was a vaginal septum extending down about two-thirds of the way from the fornices to the introitus. When a vaginal speculum was introduced on one side or the other, this mucous membrane septum was displaced completely to one side or the other, and completely hid one cervix.

The patient came in by arrangement during a clear interval. The left cervix was brought down by tenaculum, painted with Lugol's solution, cocainized topically, and then a cannula with an olive-shaped guard was inserted into the cervical canal, and, after withdrawal by suction of canal mucus, viscous skiodan was injected and roentgenograms were taken as follows: anteroposteriorly after the injection of

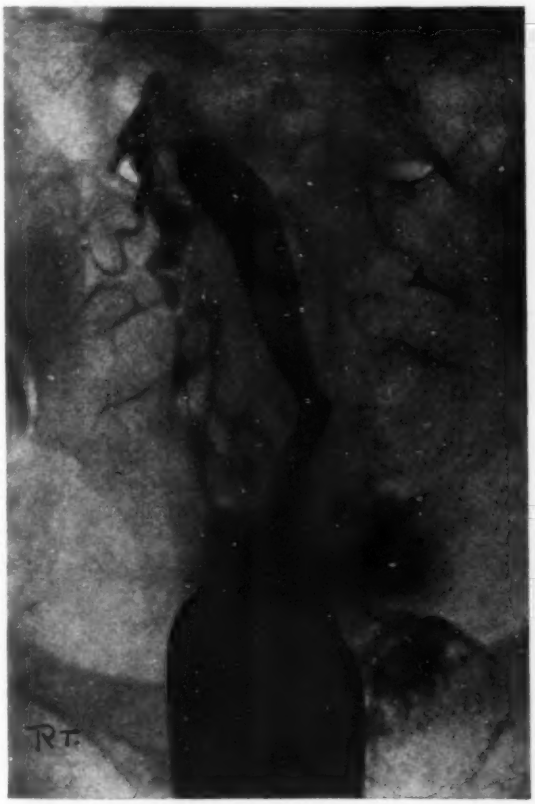

FIG. 1

FIG. 2

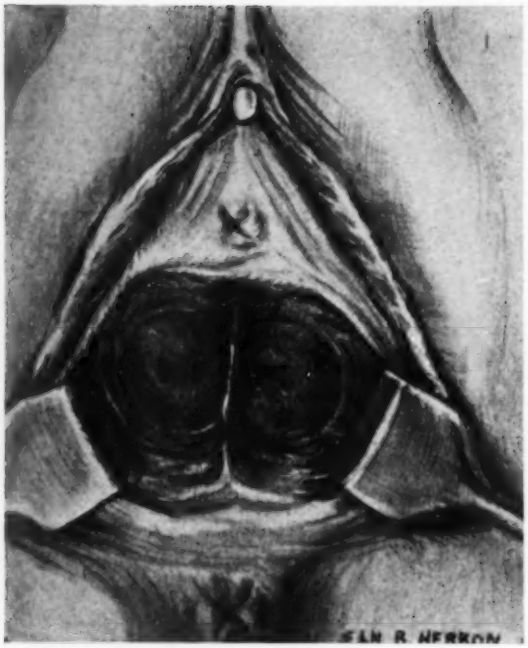

Fig. 3

each 2 cc., to a maximum of 6 cc. The same procedure was then followed in the case of the right cervix. The roentgenograms presented (Fig. 1 and 2) are those taken after the injection of 4 cc. on either side.

If the two roentgenograms are superimposed, we find a constant separation between the two uterine cavities of approximately 1 to 1.5 cm. It will be noted that there is a single tube to each of the uterine cavities which present, of course, an infantile appearance.

Gynecologists who were consulted felt that surgical intervention was not indicated, and that further pregnancies might cause development of one side or the other, sufficient to allow the patient to carry a fetus to maturity.

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VOL. 57, NO. 3

BIOLOGICAL EVALUATION OF 20 MILLION VOLT ROENTGEN RAYS

II. DECOLORATION OF HAIR IN MICE*

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INTRODUCTION

A RADIATION effect on the hair pigment has been recognized for some time. In mice and rats, irradiation is followed by decoloration of hair.† One of us (H.B.C.) has made this reaction the object of a special study. It was found that, under standardized conditions, there exists a constant relationship between dose administered, and degree of graying obtained. This relationship can be used to assay the amount of radiation delivered, or, as in this investigation, to determine the biologic effectiveness of a radiation, the dose of which is expressed in physical units.

Several characteristics of the radiation-induced graying of the coat have been determined.[1] The loss of pigment does not occur in hair present at the time of irradiation, but only in hair developing afterwards. The degree of graying for a given dose is determined by the condition of the hair at the time of irradiation. It is less pronounced if the hair is growing at the time of treatment, more pronounced in hair which starts growing only after the treatment. On the other hand, sensitivity as far as epilation is concerned is more pronounced in growing than in resting hair. The coloration remains approximately constant during the further life of the animal in spite of repeated hair generations. The pigment loss is restricted to the irradiated area. Doses below 250 r cause no recognizable graying, doses of about 1,000 r result in complete decoloration. Between these extremes, the degree of graying increases with the dose. The relation between dose and response does not change significantly with age and weight, or with variations of the rate of delivery between 5 r per minute and 670 r per minute.

MATERIAL AND METHODS

The mice used in all experiments considered in this paper were of the inbred strain C57 Black. The mice were treated in two groups of 6, and two of 2 mice each. Small skin areas were plucked before, and at intervals after the irradiation.[1] In addition, we used 3 mice surviving a betatron experiment done in October, 1944. In these mice, the estimate was based on the maximum amount of graying observable.

For the high energy irradiations, we used a roentgen-ray beam produced at 20 million volts, by the betatron. The mice were put into a phantom which consists of a large block of pressdwood with six 1 inch holes bored so that their axes lie on one isodose surface, and their near end is beyond the point where electronic equilibrium is established.[2] The standard treatment with which the betatron results were compared was delivered at 200 kv., no filter, the mice being placed in a cell below the surface of a large block of pressdwood, and irradiated through a 20 by 20 cm. field at a rate of about 100 r per minute.[3]

The determinations of the degree of graying were performed by one of us (H.B.C.) who at the time of reading was not informed about the doses applied. The effect was determined by comparing the decoloration obtained with the reaction observed in mice which had been treated with known doses of rays under standard conditions (200 kv.) and expressed by estimating the amount of standard radiation which would have produced the same amount of graying—this is called the equivalent dose.

As a physical unit of dosage we chose the reading obtained on a Victoreen condenser r-meter, the thimble chamber being placed (for both standard radiation and betatron) in the phantom at the same place as the test objects.

† As far as we know, this reaction has not been observed in man.

* From the Department of Zoology, University of Illinois, Department of Radiology, Carle Hospital Clinic, and Department of Physics, University of Illinois.

TABLE I

EFFECTIVENESS OF 20 MILLION VOLT ROENTGEN RAYS WITH REGARD TO DECOLORATION OF HAIR IN MICE

Experiment No.	r/min.	Mouse No.	Actual dose[1] (r)	Equivalent dose[2] (r)	Factor[3]	Remarks
1	30	1	752	400	0.53	
		2	776	500	0.64	
		3	805	600	0.75	
2	38	1	422	350	0.83	
		2	432	300	0.69	
		3	500	375	0.75	
		4	597	450	0.75	
		5	750	600	0.80	
		6	931	—	—	Died 11th day
3	45	1	277	less than 250	—	
		2	389	250	0.64	
		3	467	325	0.70	
		4	546	400	0.73	
		5	670	475	0.71	
		6	852	—	—	Died 7th day
4	98	1	626	475	0.76	
		2	641	425	0.66	
5	99	1	550	325	0.59	
		2	620	450	0.73	

Average factor: 0.70.
Standard deviation: 0.08.

[1] As measured on the Victoreen r-meter.
[2] Determined by comparison with mice treated with known doses of conventional (200 kv.) roentgen rays.
[3] The number with which a measured amount of high energy radiation (actual dose) must be multiplied in order to obtain the dose of conventional rays which produces the same reaction (equivalent dose).

RESULTS

Qualitatively, the graying produced by the betatron is indistinguishable from that produced by a conventional deep therapy machine. Quantitatively, referred to the common physical standard of the Victoreen dosimeter, the high energy radiation is less effective. Table 1 shows the individual estimates of effectiveness; the "factor" is the quotient of equivalent dose (i.e. the dose of standard radiation which would have produced the same effect) over actual dose.

The quantitative results are as follows: (1) the factor is smaller than "one" in every single determination; (2) the average factor, for all determinations, is 70 per cent; (3) the standard deviation for single determinations is 8 per cent.*

DISCUSSION

We want to discuss the results of this investigation from two points of view: we will analyze, first, how far they help to confirm the presence of a quantitative difference in effectiveness between high and low energy rays; and, second, whether they give any new information about the nature of such a difference.

* This standard deviation is higher than the one obtained with conventional rays; this is, thus far, a common experience in all biological betatron experiments.

Throughout this series of investigations, we are comparing the effects of high and low energy rays (20 million volt and 200 kilovolt, respectively) with regard to a physical dosimeter, on the one hand, and living test objects, on the other. The experimental conditions are such that, as far as possible, all differences except that of quality are eliminated. It was previously found[2] that betatron doses which are equivalent to conventional rays as far as the Victoreen r-meter indicates, are only 78 per cent as effective if measured by the survival time of mice; and, as the experiments reported in this paper show, they are only 70 per cent as effective if measured by the graying of the coat. The difference between the two factors (70 per cent and 78 per cent) is small, and to establish whether or not it is significant would necessitate a large amount of additional experimentation which we are not prepared to perform at this time. We leave undecided whether we have obtained two different factors, or two determinations of the same factor. We turn to the question whether the two series of experiments yield actually independent results. This can be said to be so if the two reactions are significantly different. We feel this is the case. The graying of the coat is a local reaction, roentgen death a general one; one arises in the skin, the other presumably in deep organs; one does not depend on age and weight, the other does so very markedly. Besides, the dosage ranges of the two reactions are different. Thus we conclude that we have obtained essentially new evidence of a difference in quantitative effectiveness between the rays produced by the betatron and those of a conventional deep therapy machine.

However, because of the similarity—or, possibly, identity—of the two conversion factors, we do not know any more than we did before about the nature of the difference. What we call—at present—identical physical doses are amounts of radiation which produce identical responses of the Victoreen r-meter, the measurements being obtained with the thimble chamber introduced into the phantom at the place of the test objects. It is by no means certain that such identical responses signify identical numbers of roentgens. A different type of iometer might lead to a different factor. At the present time, no absolute standard for high energy radiation exists. In the meantime, we feel that the Victoreen r-meter is a satisfactory instrument. It permits the establishment of a consistent and reproducible relation between a physical measurement and a biological reaction, and that is all that is needed for clinical work.

SUMMARY

1. Graying of the coat in mice is produced by appropriate doses of roentgen rays. It occurs with high and low energy rays (20 million volt and 200 kilovolt, respectively).

2. Quantitatively, the two radiations are not equally effective. If the effectiveness of high and low energy rays with regard to the Victoreen r-meter is considered identical, then the effectiveness of high energy rays with regard to graying of the coat is 70 per cent of the effectiveness of low energy rays.

The experiments were performed on the University of Illinois betatron. We wish to express our gratitude to the whole staff of the betatron laboratory, especially to Mr. L. H. Lanzl for his assistance with the experiments.

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OIL CIRCULATION IN DIAGNOSTIC ROENTGEN TUBES*

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ONE of the significant developments which have occurred during the war in the field of diagnostic roentgenology has been the incorporation of oil circulation in shock-proof, stationary anode roentgen-ray tubes. By this innovation, the heat liberating capacity of such tubes has been considerably improved with a resulting increase in tube life and operational capacity. All of the tubes supplied with the Army field units during the war utilized oil circulation. The records of performance have been excellent in almost every respect.

The concept of employing oil circulation to improve the cooling of roentgen tubes and equipment is not new. Hodges[1] employed the procedure in 1919. Through the years, the U. S. Patent Office has received several applications from a number of sources for patents covering oil circulating systems. Furthermore, cooling by this method is widely used in roentgen therapy. It is rather surprising in view of these facts that oil circulation has not been adapted to diagnostic tubes by American manufacturers before this time. One explanation for this fact may possibly be found in the general belief that in standard stationary-anode tubes there is a considerable agitation of the oil established by the electrostatic field occurring when high potentials are impressed on the tube and that therefore auxiliary means of circulation are unnecessary. As we shall see presently, such reasoning is in error.

The heat generated within a roentgen tube is liberated in two ways. Some is radiated directly from the anode to the surrounding structures (oil and tube shell). Present day rotating anode tubes dissipate almost all of their heat in this manner. A second means of heat liberation is the process of conduction. Heat generated at the target is conducted first along the anode to its distal end, then through the oil to the outside air. Most of the heat generated within a stationary-anode tube is lost in this manner.

It will be observed that in the conduction process the heat transfer occurs in three stages: first through the anode, then through the oil, finally into the surrounding air. Inefficiency within any one of these stages will cause the anode of a tube to assume a higher temperature than would otherwise be the case. Air circulation, produced by suitable fans mounted on the tube housing, has long been employed to improve the efficiency of heat transfer from the tube housing into the surrounding air. It is the purpose of oil circulation to improve heat transfer from anode to tube housing. By a combination of oil and air circulation one would expect the anode of the tube to operate at minimum temperature under a given set of conditions. Since low anode temperature is contributory to long tube life, stationary anode tubes therefore should provide both types of circulation. In rotating-anode tubes, the need for oil circulation is not so great since only a small quantity of heat is lost by conduction. However, since the oil is the recipient of some of the heat lost by radiation, oil circulation even here may have some advantage.

The use of oil and air circulation presents its greatest advantage in tubes operating continuously, as in fluoroscopy and in tubes operating at rapid exposure rates (mass roentgenography and spot-filming fluoroscopy). It does not improve significantly the instantaneous loading of a tube. The problem in short, high energy exposures is the transfer of heat from the target area into the deeper portions of the

[1] Hodges, P. C. Personal communication.

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anode. Such a transfer will be facilitated by maintaining the average anode temperature at a low level, of course, but the temperature reached by the target during a high energy exposure is so much greater than that of the surrounding anode that the transfer will not be greatly affected by actual anode temperature.

To date, there have been published no quantitative data upon the effectiveness of oil circulation in diagnostic roentgen tubes. Since such information would be of value to engineers in meeting tube-design problems and to physicians in planning roentgenological procedures, an Army airflow tube equipped with oil circulation was obtained for study in the laboratory of the Radiology Section, Tuberculosis Control Division, U. S. Public Health Service. With the assistance of the tube manufacturer, the anode of the tube was drilled to within one-half inch of the target to allow insertion of a thermocouple. Another thermocouple was fastened to the distal end of the anode. The positions of these thermocouples are shown in relation to the anode and surrounding structures within the tube housing in Figure 1. Other thermocouples were fastened to the outside of the tube housing opposite the anode sleeve, opposite the target and opposite the cathode sleeve.

The tube was then operated continuously in a horizontal position at a potential of 35 kilovolts from a constant-potential generator at currents ranging to 4 milliamperes. Under these conditions of potential and current, the energy input to the tube operating continuously was equal to the energy input to a tube operating intermittently at rates up to the equivalent of three 0.25 second exposures per minute at 85 peak kilovolts and 200 milliamperes. The anode was maintained at ground potential to permit continuous recording of the anode temperatures. Temperature recordings were made with the tube having (1) neither oil or air circulation, (2) oil circulation only, (3) air circulation only and (4) oil and air circulation. When no air

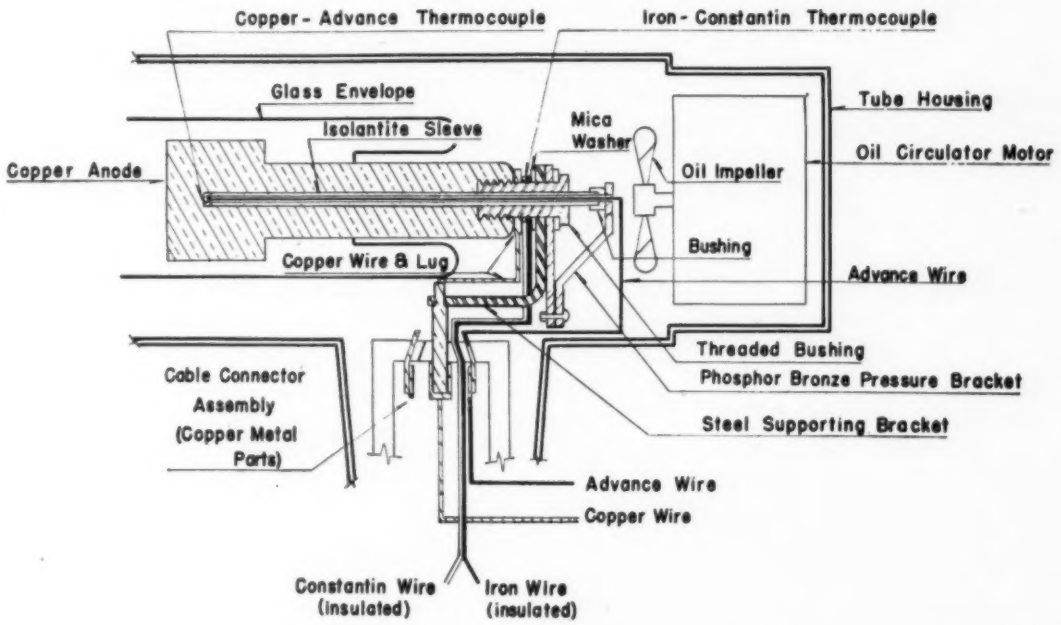

Fig. 1. Schematic diagram of Army airflow tube to illustrate positions of thermocouples with which temperature of anode was measured under operating conditions. Anode of tube is shown in relationship to glass envelope of tube, tube housing and oil impeller.

circulation was employed, the fan and the attached baffles which normally enclose the tube housing were removed to improve heat liberation.

The temperatures reached by the target end of the anode, the housing end or stem of the anode and the housing opposite the anode sleeve are shown graphically for these four conditions of circulation in Figure 2; temperatures are plotted against the power input of the tube (i.e. kilovolts×milliamperes). The data for the target end of the anode are collected together in Figure 3. There it will be seen that the anode becomes progressively hotter as the power consumed increases for all conditions of circulation. However, the highest temperatures are reached for a particular power input when no circulation is present. When either oil or air circulation is present, the anode operates somewhat cooler than when no circulation is employed. However, when both air and oil circulation are used, the anode temperature

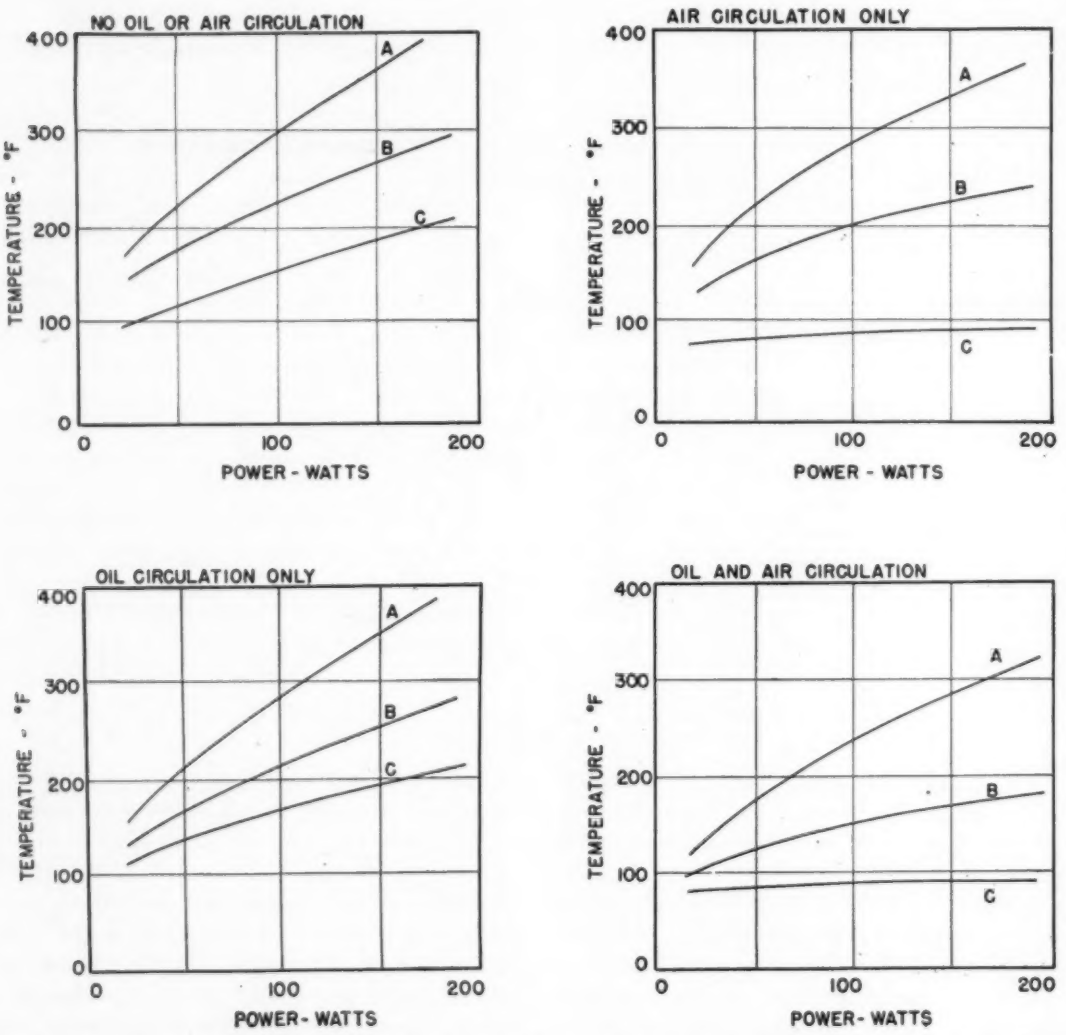

FIG. 2. Temperature of target end of anode (Curve A), housing end of anode (Curve B), and tube housing (Curve C) plotted as a function of the power input of the tube for four operating conditions—no oil or air circulation, oil circulation only, air circulation only, and air and oil circulation.

drops considerably; indeed, the tube may be operated at twice the power input applied under conditions of no circulation for the development of the same anode temperature.

The differences in temperature between the two ends of the anode under the four conditions of circulation are plotted against the power consumed by the tube in Figure 4. It will be observed that, regardless of the type of circulation used, all of the curves follow essentially the same locus. That is, the difference in temperature between the

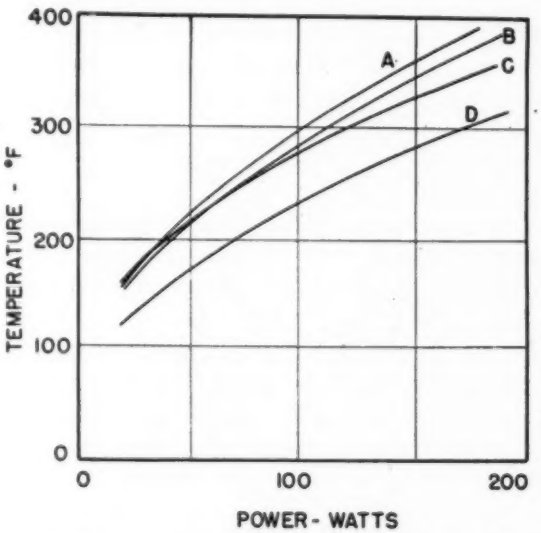

Fig. 3. Temperature of target end of anode plotted as a function of the power input of the Army inflow tube. Curve A, no oil or air circulation; Curve B, oil circulation only; Curve C, air circulation only; Curve D, air and oil circulation.

two ends of the anode for a given power input are approximately the same regardless of whether circulation is present or absent. This, of course, is what one would expect, because the rate of heat transfer by conduction depends on the temperature gradient of the conductor. Hence, for the dissipation of a given amount of heat (power input) the temperature gradient must be the same regardless of the temperature of the anode and the types of circulation provided all of the heat is lost by conduction. The loss of some of the heat by radiation explains the minor variations

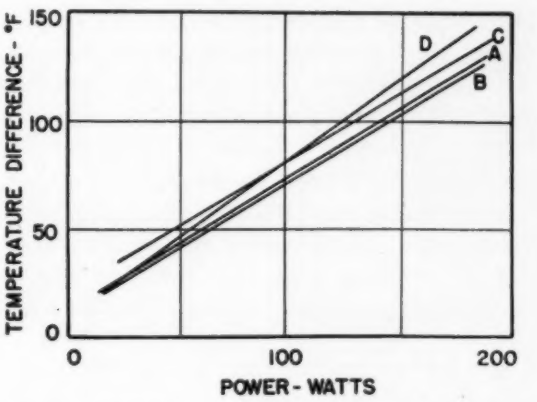

Fig. 4. Temperature difference between target end and housing end of anode plotted as a function of the power input of the Army airflow tube. Curve A, no air or oil circulation; Curve B, oil circulation only; Curve C, air circulation only; Curve D, air and oil circulation.

in the loci of the curves in Figure 4. Obviously where the temperature gradient is low for a particular power input, the quantity of heat lost by conduction is relatively low. When it is high, the loss by conduction is large.

The temperature differences occurring between the housing end of the anode and the housing for the four conditions of circulation are shown in Figure 5. Curve A is for no circulation, Curve B for oil circulation, Curve C for air circulation and Curve

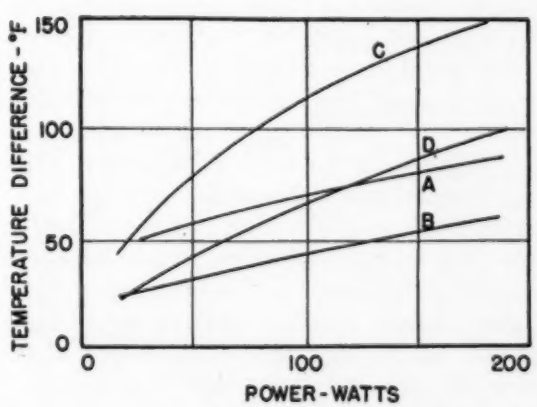

Fig. 5. Temperature difference between housing end of anode and tube housing plotted as a function of the power input of the Army airflow tube. Curve A, no oil or air circulation; Curve B, oil circulation only; Curve C, air circulation only; Curve D, air and oil circulation.

D for oil and air circulation. It will be observed that when oil circulation is present, the temperature differences are smaller than when it is not employed.

Thus, the heat transfer from anode to housing is facilitated by oil circulation. It is noteworthy, however, that at high power inputs, the temperature difference is as great or greater when the combination of oil and air circulation is present as when no

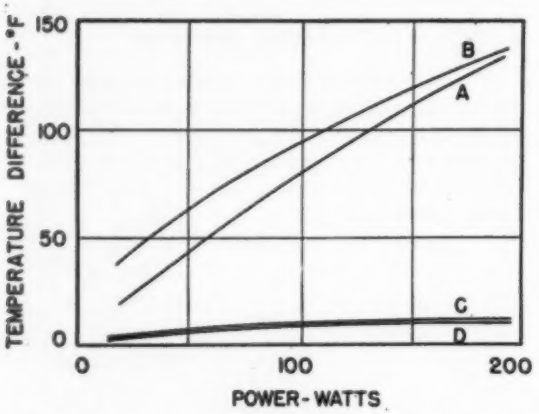

Fig. 6. Temperature difference between tube housing and the surrounding air plotted as a function of the power input of the Army airflow tube. Curve A, no oil or air circulation; Curve B, oil circulation only; Curve C, air circulation only; Curve D, oil and air circulation.

circulation is employed. Since the heat transfer under the latter condition is poor, this can only mean that under conditions of no circulation very little heat is transferred through the oil from anode to tube housing by conduction but instead is liberated by the process of radiation. The high temperature difference occurring when air and oil circulation are present is probably due to the rather inefficient type of circulation system used in the tube. The system simply consists of a motor-driven impeller which agitates the oil. There is no systematized circulation and there is no attempt to increase the contact between the anode and the oil beyond that occurring in standard tubes. It would appear that if the housing end of the anode were fitted with fins and an effort made to direct the flow of oil against them, the temperature of the anode might be reduced from 25 to 75 degrees. This would provide sufficient cooling to triple the capacity of the tube over the no-circulation condition.

The temperature differences occurring between the tube housing and the surrounding air for the four conditions of circulation are illustrated in Figure 6. Curve A represents conditions when no circulation is present, Curve B when oil circulation is employed, Curve C when air circulation is present and Curve D when both oil and air circulation is used. Here there is evident a rather spectacular reduction in the temperature differences when air circulation is present. Indeed the air circulation system as it now stands appears to be a very effective agent for the transfer of heat from the tube housing to the surrounding air.

As previously stated, the foregoing data were obtained with the anode of the tube maintained at ground potential. Accordingly it may legitimately be argued that the oil circulation data do not give a true picture of normal operating conditions since, when the anode is grounded, there is no circulation of oil induced electrostatically. This point was recognized and an effort was made to determine as far as possible the effect of electrostatic oil circulation. It was reasoned that, if electrostatic circulation is significant, the difference in the temperature of the tube housing with and without mechanical agitation of the oil should be considerably less when electrostatic circulation occurs than when it does not. The tube was arranged to test this point. Measurements of the temperature of the tube housing were made first with the anode at ground potential and then with the anode at an above-ground potential of 50 per cent of the cathode-anode potential. No significant change was observed in the difference of the housing temperature under conditions when mechanical agitation was and was not used for the situation favoring electrostatic circulation and for the situation eliminating such circulation. It therefore appears that elec-

trostatic oil circulation is not a significant factor in the transfer of heat from the anode to housing of a roentgen tube. Furthermore, under normal roentgenographic conditions, electrostatic circulation is extremely brief, lasting only as long as the exposure. Thus its effectiveness must indeed be small.

SUMMARY

Quantitative data indicating the effectiveness of the oil circulation system of the so-called Army airflow stationary-anode roentgen tube have been given. This material indicates that when such a circulation system is combined with a suitable air circulating mechanism for cooling the tube housing, the tube operates at a considerably reduced temperature and may be expected to perform satisfactorily under more rigorous conditions than normally. Even better performance than that now obtained may be achieved by improving the present oil circulation design.

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EDITORIALS

THE EVALUATION OF POST-IRRADIATION PROGNOSIS IN CANCER OF THE CERVIX

THE prognostic evaluation of a given case of cancer of the cervix treated by radiation therapy has constituted an important topic from the earliest days. In particular the efforts of trying to interpret the radiosensitivity of a tumor in terms of cellular activity were numerous. By 1915 it was possible to apply the well known law of Bergonié and Tribondeau to most types of cancer.

In regard to cancer of the cervix, it was noted that tumors composed of embryonal cells were more sensitive than anaplastic tumors of equally cellular character and that the degree of radiosensitivity ran to a certain extent parallel to the degree of anaplasia of the tumor cells. There were other prominent factors to be considered, as for example, the vascularity of the tumor, the role of the tumor bed and the desmoplastic property of the tumor or its capacity to produce connective tissue.

In 1920 Broders[1] published his now universally used classification of epidermoid cancer into four histopathologic groups based on the degree of differentiation of the malignant cells. Grade 1, or the least malignant, contains from 0 to 25 per cent undifferentiated cells, Grade 2 from 25 to 50 per cent, Grade 3 from 50 to 75 per cent and Grade 4 from 75 to 100 per cent. Healy and Cutler[2] in 1928 adapted this classification to carcinoma of the cervix. By taking into consideration the degree of anaplasia of the cells and the relative amount of stroma present they established three major groups of cancer of the cervix: (1) the adult type, composed of highly differentiated cells, with a tendency to hornification and pearl formation, resistant to irradiation; (2) the plexiform type, composed of moderately anaplastic cells with few or no squamous characters, arranged in a plexiform manner and showing a tendency toward infiltration, rather radiosensitive; and (3) the anaplastic type, composed of undifferentiated cells, with complete loss of squamous characters and showing a tendency to diffuse infiltration, highly radiosensitive. It was determined that, on an average, one out of every five cancers of the cervix belongs to Group 1, three to Group 2 and one to Group 3. In other words, about 80 per cent of all cancers of the cervix are radiosensitive and only 20 per cent radioresistant, although the administration of a cytocaustic dose, in association with intracavitary radium or intravaginal roentgen therapy, may lead to a cure even in some of the early cases of this latter group.

However valuable this histopathologic grading may be from the point of view of prognosis of the respective group as a whole, it has little significance when it comes to estimating the result of treatment in the individual case. A correlation with the influence of the clinical stage of the carcinoma was attempted but beyond the fact that a slightly better insight is gained in the larger groups, this, too, remained fruitless. At the present time, the five year follow-up requiring considerable patience and long waiting is our only true way of expressing the final result of treatment in the individual case of cancer of the cervix.

Recently some attempts have been made to introduce quicker methods. Two of these are of particular interest.

The first concerns serial biopsies taken

[1] Broders, A. C. Squamous-cell epithelioma of the lip. *J.A.M.A.*, 1920, *74*, 656–664; also, Epithelioma of the genito-urinary organs. *Ann. Surg.*, 1922, *75*, 574–604.

[2] Healy, W. P., and Cutler, M. Relation between structure and prognosis in cervical carcinoma under radiation treatment. *Am. J. Obst. & Gynec.*, 1928, *16*, 15–28.

before, during and after treatment. Glücksmann and Spear,[3] after long series of investigations found that the cellular population of most epithelial tumors, and hence of cancer of the cervix, is represented by four cell categories, two of which are viable and two non-viable. The viable cells are called resting cells and mitotic cells. The resting cells are intermitotic "stock" cells possessing in the different types of tumors a capacity for either division or differentiation. They are characterized by a large, often hyperchromatic, nucleus and a relatively small basophilic cytoplasm. The mitotic cells are "stock" cells undergoing division. The non-viable cells are called differentiating and degenerating cells. The differentiating cells are large cells containing a relatively small vesicular nucleus and considerable differentiated cytoplasmic structure which renders the cell incapable of division. The degenerating cells assume varying forms according to the type of degeneration (mucoid, fatty, etc.). The ratio of these four cell categories in a given tumor is influenced by the blood supply and the composition of the tumor bed which stimulate or inhibit mitosis, differentiation and degeneration.

Irradiation affects the cell population either directly or indirectly. The direct effect occurs chiefly on the viable resting cells and mitotic cells, consisting in breaking down the division or producing a complete degeneration. If the exposure is not too large, an abnormal cell division may result, terminating eventually in non-viable cells or leading to recurrence of the carcinoma. The indirect effect manifests itself through interference with the blood supply and the connective system of the tumor bed. Both the direct and indirect changes are dependent on the type of the original tumor, the total dose administered, the intensity rate at which treatment is given and on the time factor if the irradiation is carried out by the fractionated protracted method.

Glücksmann and Spear[3] determined that it is possible to gain some idea about the future outcome in an individual case of cancer of the cervix by making systematic counts of the four cell categories in serial biopsies. By plotting the percentage cell counts on the ordinates and the time in days on the abscissae of graphs they obtained more or less typical reaction charts. In a favorably responding cancer, as a rule, a rapid reaction to irradiation was noted. There was a rapid increase in the percentage of the differentiating and disintegrating cells with a corresponding decrease of the percentage of the resting and mitotic cells. In such instances the cancer healed within three months and the patients remained well. In a moderately responding cancer a reduction in the percentage of the viable cells occurred associated with a corresponding increase in the percentage of the non-viable cells, but unless a complete disappearance of the viable cells was obtained through subsequent treatment the tumor tissue recovered from the effect of the irradiation. Clinically, here the cancer may have temporarily disappeared but later recurrence developed in the treated area and the patients died. In the unfavorably responding cancer the reaction chart showed only minor fluctuations of the four cell categories, indicating that except for a temporary depression the tumor activity continued practically unchanged despite the irradiation. Such patients died within a relatively short period following the treatment.

Glücksmann and Spear[3] emphasize the fact that in order to obtain comparable data it is necessary to take the serial biopsies from the edge of the growing tumor. The specimens so obtained are sectioned and young foci formed by papillary projections of tumor strands into normal tissue are chosen for analysis.

The quantitative histopathologic examination of serial biopsies was used by

[3] Glücksmann, A., and Spear, F. G. Qualitative and quantitative histological examination of biopsy material from patients treated by radiation for carcinoma of cervix uteri. *Brit. J. Radiol.*, 1945, *18*, 313–322; also Glücksmann, A. Quantitative histological analysis of radiation effects in human carcinomata. *Brit. Med. Bull.*, 1946, *4*, 26–30.

Glücksmann and Spear[3] in 150 routine cases of cancer of the cervix treated by radiation therapy. In 26 of these the reaction charts obtained within three weeks from beginning of treatment showed the persistence of tumor activity when, clinically, there was a satisfactory response during the first four months after irradiation. In each case a recurrence developed during the succeeding eight months. Thus it seems that the findings are true measures of the behavior of the cancer under the influence of the radiation therapy given and that the reaction chart is a useful guide of prognostic evaluation in the individual case.

Another method concerns the histopathologic study of the vaginal smear and a report of this has just been published. For obvious reasons such approach if workable is of considerably greater practical value than the taking of serial biopsies. Vaginal smears can be obtained at random during any desirable phase of the course of irradiation and long thereafter in the follow-up period. Furthermore, they permit a simultaneous study of all the cell elements, whether normal or abnormal, of the cervical and vaginal mucosa.

After initial work in conjunction with Meigs and his associates,[4] Graham[5] in two articles gives a detailed account of the applicability of this method. The first article deals with the immediate and late cellular changes as observed in vaginal smears as a result of irradiation of cancer of the cervix. The second article attempts, on the basis of these findings, a prognostic evaluation in the individual case.

Graham[5] distinguishes two types of reaction. The first is found when there is a good response to irradiation, the second when there is little or no response. In contradistinction to Glücksmann and Spear[3] who consider only the various categories of the malignant cells as basic factors, Graham[5] also includes the changes of the normal cells of the cervical and vaginal mucosa in determining the type of reaction present. The charts otherwise are prepared in a manner similar to those of Glücksmann and Spear,[3] the percentage of cells being plotted on the ordinates and the time in days on the abscissae. The percentage of the malignant cells is computed by taking the maximum incidence of these cells encountered in any of the smears of that particular case as 100 per cent, while the percentage of the affected normal cells is based on 100 per cent equalling a change in all normal epithelial cells.

According to Graham[5] the cytology of the normal vaginal smear is characterized by the presence of elements which desquamate from the various layers of the vaginal and cervical mucosa. The basal cells originate from the deepest layer of the epithelium. They show considerable variation in the size of the basophilic cytoplasm depending on their position in the basal layer but the nuclei are of about the same size. The precornified and cornified cells originate from the intermediary and superficial layers respectively of the epithelium. The former have a large wrinkled or granulated basophilic cytoplasm, the ratio between the cytoplasm and nucleus being much greater than in the basal cells. The latter are similar to the precornified cells but the nucleus is small and the cytoplasm is acidophilic. In addition, the normal vaginal smear often contains leukocytes, mostly of the polymorphonuclear type, and histiocytes which may be of the small, phagocytic, or of the foreign body giant cell variety.

In case of epidermoid carcinoma of the cervix the malignant cells encountered in the vaginal smear are either differentiated or undifferentiated. The differentiated cells show rather bizarre shapes, resembling a tadpole or a muscle fiber. The undifferentiated cells are similar to the basal cells

[4] Meigs, J. V., Graham, R. M., Fremont-Smith, M., Kapnik, I., and Rawson, R. W. Value of the vaginal smear in the diagnosis of uterine cancer. *Surg., Gynec. & Obst.*, 1943, *77*, 449–461; also, Meigs, J. V., Graham, R. M., Fremont-Smith, M., Janzen, L., and Nelson, C. B. Value of vaginal smear in diagnosis of uterine cancer; report of 1015 cases. *Surg., Gynec. & Obst.*, 1945, *81*, 337–345.

[5] Graham, Ruth M. The effect of radiation on vaginal cells in cervical carcinoma. I. Description of cellular changes, II. The prognostic significance. *Surg., Gynec. & Obst.*, Feb., 1947, *84*, 153–173.

except that they are smaller, have a very narrow or indistinct cytoplasm and their nuclei are hyperchromatic. In adenocarcinoma the malignant cells are, as a rule, undifferentiated, occurring in clusters and exhibiting a thin rim of cytoplasm which may encompass very small vacuoles.

Graham[5] studied the irradiation changes in the vaginal smear in a total of 206 cases of cancer of the cervix, 179 of which were epidermoid carcinoma and 27 adenocarcinoma. In a first group of 35 patients the study was carried out during the actual course of irradiation, 2 cases of bladder carcinoma with normal cervix having been added as controls. A second group of 50 patients was observed beginning immediately after the conclusion of the irradiation series and extending over a period of six months. A third group of 19 patients was seen in the follow-up period of from six months to one year after treatment and a fourth group of 102 patients in the follow-up period of from one to fifteen years after treatment.

In the first type of reaction it was noted that the effect of the irradiation always started on the normal cells. Occasionally as early as the second day, but most frequently on the ninth or tenth day the basal cells became elongated, somewhat resembling malignant fiber cells, and started to stain brown instead of blue. Then signs of degeneration appeared in the nucleus. From the twelfth day on, ballooning to from three to four times the normal size occurred followed by vacuolization of the cytoplasm and marked pyknosis or karyorrhexis of the nucleus. Toward the end of the treatment the cells assumed very bizarre forms and completely disintegrated. Similar changes, with slight variations, were observed on the precornified and cornified cells, although they occurred somewhat later, corresponding in the average case to about the fifteenth day of treatment. In nearly all cases a progressive leukocytosis started immediately after institution of the treatment and was soon followed by an increase in small histiocytes and a variable activity of the phagocytes and foreign body giant cells.

The irradiation effect on the malignant cells was usually most pronounced on the eleventh day except in a few instances in which some changes were already seen on the eighth day. The type and sequence of degeneration followed broadly the same pattern as in the normal cells. One distinguishing feature was the appearance of rather numerous multinucleated giant cells in the terminal phase of disintegration probably indicating amitotic division induced by the irradiation. After the eleventh or twelfth day most malignant cells disappeared from the smear, but the time of disappearance was not as important as the gradual decrease.

In the second type of reaction Graham[5] found little irradiation change. As a rule, the cytologic pattern of the smear remained uninfluenced. Typical unaffected normal cells persisted throughout the treatment and there was very little diminution in the number of malignant cells.

Graham also analyzed in detail the long range effect of the irradiation in the cases which were followed for a varying period of time. By correlating the data with those of biopsy studies made under similar conditions a satisfactory comparison was obtained.

Stimulated by this result Graham then used the two types of reactions for prognostic evaluation of a given case of cancer of the cervix. The procedure was applied to 73 patients of the first and second group whose follow-ups were of a sufficient length of time. The case was classified as showing a good response if the chart elicited the first type of reaction and as showing a poor response if the chart indicated the second type of reaction. In 88 per cent of the cases the outcome of the treatment was accurately foretold.

Although a period of at least five years will be required before a final conclusion can be drawn as to the ultimate prognosis, the method so ably presented by Graham appears to be of decided practical value.

T. Leucutia

JAMES MURRAY FLYNN
1882—1946

DR. JAMES MURRAY FLYNN of Rochester, New York, died of coronary disease and pneumonia at St. Mary's Hospital on December 14, 1946, at the age of sixty-four. Dr. Flynn was born in Rochester, New York, studied at Stanford University, and obtained his medical degree from the University of Buffalo Medical School in 1914.

Dr. Flynn went overseas in 1918 in World War I and served for fourteen months as a Captain and head of the Roentgen Department at Base Hospital No. 19 at Vichy, France. Upon his return to Rochester he

resumed the practice of radiology.

Dr. Flynn had always been active in medical organizations and held the office of President of the Medical Society of the State of New York, Medical Society of Monroe County, Rochester Pathological Society, and Rochester Academy of Medicine. He was a Fellow of the American College of Radiology, American College of Physicians, and Faculty of Radiologists of England. He was a diplomate of the American Board of Radiology and member of the House of Delegates of the American Medical Association from 1938–1941, and from 1943–1946. He was a member of the American Roentgen Ray Society, Radiological Society of North America, American College of Radiology and American Radium Society.

He was the author of several articles which were published in the radiological literature.

For the last twenty-five years Dr. Flynn was Radiologist at St. Mary's Hospital and Park Avenue Hospital, and was on the Staff of the Rochester General Hospital, Strong Memorial Hospital and Monroe County Hospital.

A blunt, sincere individual with tremendous drive, Dr. Flynn will long be remembered by his contemporaries. He possessed the ability and determination to accomplish the things he undertook and could always be counted upon to represent the medical profession fairly and to protect its interests when the occasion arose. His enthusiasm was infectious and his fresh approach was most stimulating to his associates. His personality and his sincerity won him a large circle of friends both in the profession and with the public. He will be sorely missed by all who knew him.

He is survived by his wife, Mrs. Mae Linneman Flynn; a son, James E. Flynn; four daughters, Madame José of the Order of the Sacred Heart at Tarrytown, New York; Mrs. William St. Paul of Scarsdale, New York, and Margaret and Nancy Flynn of Rochester, New York.

S. C. Davidson

RICHARD MANGES SMITH
1901—1946

RICHARD MANGES SMITH died on December 20, 1946, after a lingering illness. His last years had been a slowly progressive decline due to the ravages of multiple sclerosis. All through his illness he had borne his affliction with great patience and fortitude, always maintaining an unusually high morale and cheery outlook.

Dr. Smith was born on January 25, 1901, at York, Pennsylvania. He was the son of George E. and Leah Jenny Manges Smith. His mother was the sister of the late Dr. Willis F. Manges, and Dr. Smith was later trained under this pioneer in radiology. He

was educated at Gettysburg College and received the degree of B.S. in 1923. He later attended Jefferson Medical School, Philadelphia, and received his degree from this institution in 1927, later interning at Jefferson Hospital from the year 1927 to 1929.

He began his career as a radiologist under the tutelage of his distinguished uncle, Dr. Willis F. Manges, as an Assistant Demonstrator in Roentgenology at Jefferson Medical College and assistant in the Department of Roentgenology at Jefferson Hospital. He held this appointment from 1929 to 1932. He was later elevated to the position of Instructor in Roentgenology in 1933 and held this post until 1936. Since that time he had held the position of Demonstrator of Roentgenology, advancing in his specialty with the years. In 1936 he was stricken with the infirmity to which he eventually succumbed. Since 1939 he had been inactive.

In 1939 he married Marion E. Bowers who was his faithful companion and nurse throughout his illness and she evidenced the greatest devotion and sacrifice for her invalid husband. She set an example which all her friends and relatives look upon with great admiration and sympathy.

Dr. Smith's advance in the profession was recognized by his election to membership in the American College of Radiology, the American Roentgen Ray Society, the Radiological Society of North America, the Philadelphia Roentgen Ray Society, the County Medical Society, the American Medical Association, and the College of Physicians and Surgeons of Philadelphia. He was a member of Nu Sigma Nu and Sigma Alpha Epsilon fraternities. During his short, but fruitful career Dr. Smith had found time nevertheless to add a number of articles to the literature, his bibliography including nine publications, most of them being in co-authorship with confrères in his profession. He was also interested in the hobby of collecting books and coins.

Dr. Smith, during his short career, had gained many friends in the profession all of whom admired him, not only for his accomplishments, but for his integrity, his friendly personality, and great sense of humor. In his passing, Jefferson has lost a valuable and loyal son and the profession of radiology, one of its outstanding personalities.

Paul C. Swenson

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SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. H. Dabney Kerr, University Hospital, Iowa City, Iowa. Annual meeting: Haddon Hall, Atlantic City, N. J., Sept. 16–19, 1947.

American College of Radiology
Secretary, Mac F. Cahal, 20 N. Wacker Drive, Chicago 6. Annual meeting: Haddon Hall, Atlantic City, N. J., June 8, 1947.

Section on Radiology, American Medical Association
Secretary, Dr. U. V. Portmann, Cleveland Clinic, Cleveland, Ohio. Annual meeting: Atlantic City, N. J., June 9–13, 1947.

American Radium Society
Secretary, Dr. H. F. Hare, 605 Commonwealth Ave., Boston, Mass. Annual meeting: Seaside Hotel, Atlantic City, N. J., June 9–10, 1947.

Alabama Radiological Society
Secretary, Dr. John D. Peake, Mobile Infirmary, Mobile Ala. Next meeting time and place of Alabama State Medical Association.

Arkansas Radiological Society
Secretary, Dr. Fred Hames, 511 National Bldg., Pine Bluff, Ark. Meets every three months and also at time and place of State Medical Association.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N. Y. Annual meeting: 1947, to be announced.

Radiological Section, Baltimore Medical Society
Secretary, Dr. Walter L. Kilby, Baltimore. Meets third Tuesday each month, September to May.

Section on Radiology, California Medical Association
Secretary, Dr. D. R. MacColl, 2007 Wilshire Blvd., Los Angeles 5, Calif.

Radiological Section, Connecticut Medical Society
Secretary, Dr. Robert M. Lowman, Grace-New Haven Community Hospital, New Haven 11, Conn. Meets bimonthly on second Thursday, at place selected by Secretary.

Section on Radiology, Illinois State Medical Society
Secretary, Dr. H. W. Ackemann, 321 W. State St., Rockford, Ill.

Radiological Section, Los Angeles Co. Med. Assn.
Secretary, Dr. Moris Horwitz, 2009 Wilshire Blvd., Los Angeles 5, Calif. Meets on second Wednesday of each month at the County Society Building.

Radiological Section, Southern Medical Association
Secretary, Dr. Roy G. Giles, Temple, Texas.

Brooklyn Roentgen Ray Society
Secretary, Dr. A. H. Levy, 1354 Carroll St., Brooklyn 13, N. Y. Meets monthly on fourth Tuesday, October to April.

Buffalo Radiological Society
Secretary, Dr. Joseph S. Gian-Francheschi, 610 Niagara St., Buffalo, N. Y. Meets second Monday of each month except during summer months.

Chicago Roentgen Society
Secretary, Dr. T. J. Wachowski, 310 Ellis Ave., Wheaton, Ill. Meets second Thursday of each month October to April inclusive at the Palmer House.

Cincinnati Radiological Society
Secretary, Dr. Samuel Brown, 707 Race St., Cincinnati, Ohio. Meets third Tuesday of each month, October to May, inclusive.

Cleveland Radiological Society
Secretary, Dr. George L. Sackett, 10515 Carnegie Ave. Cleveland 6, Ohio. Meetings at 6:30 P.M. on fourth Monday of each month from October to April.

Dallas-Fort Worth Roentgen Study Club
Secretary, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meets in Dallas on odd months and in Fort Worth on even months, on third Monday, 7:30 P.M.

Denver Radiological Club
Secretary, Dr. W. C. Huyler, 1619 Milwaukee, Denver 6, Colo. Meets third Friday of each month at Department of Radiology, Colorado School of Medicine.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. E. R. Witwer, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

Florida Radiological Society
Secretary, Dr. J. M. Dell, Jr., 333 W. Main St., S., Gainesville, Fla. Meetings in May and November.

Georgia Radiological Society
Secretary, Dr. James J. Clark, 478 Peachtree St., Atlanta, Ga. Meets in November and at annual meeting of Medical Association of Georgia in the spring.

Radiological Society of Kansas City
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

Illinois Radiological Society
Secretary, Dr. Wm. DeHollander, St. John's Hospital, Springfield, Ill. Meets three times a year.

Indiana Roentgen Society
Secretary, Dr. J. A. Campbell, Indiana University Hospitals, Indianapolis 7. Meets second Sunday in May.

Iowa X-Ray Club
Secretary, Dr. Arthur W. Erskine, 326 Higley Bldg., Cedar Rapids, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society. Special meetings by announcement.

Kentucky Radiological Society
Secretary, Dr. W. C. Martin, 321 W. Broadway, Louisville. Meets annually in Louisville on first Saturday in Apr.

Long Island Radiological Society
Secretary, Dr. Marcus Wiener, 1430-48th St., Brooklyn, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:30 P.M.

Louisiana Radiological Society
Secretary, Dr. J. R. Anderson, 1130 Louisiana Ave., Shreveport. Meets annually during Louisiana State Medical Society Meeting.

Michigan Association of Roentgenologists
Secretary, Dr. E. M. Shebesta, 1429 David Whitney Bldg., Detroit. Three meetings a year, Fall, Winter, Spring.

Milwaukee Roentgen Ray Society
Secretary, Dr. C. A. H. Fortier, 231 W. Wisconsin Ave., Milwaukee, Wis. Meets monthly on second Monday at University Club.

Minnesota Radiological Society
Secretary, Dr. Chauncey N. Borman, 802 Medical Arts Bldg., Minneapolis 2, Minn. Two meetings yearly, one at time of Minnesota State Medical Association, the other in the fall.

Nebraska Radiological Society
Secretary, Dr. O. A. Neely, 924 Sharp Bldg., Lincoln, Neb. Meets third Wednesday of each month, at 6 P.M. at either Omaha or Lincoln.

* Secretaries of societies not here listed are requested to send the necessary information to the Editor.

New England Roentgen Ray Society
Secretary, Dr. George Levene, Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday, Boston Medical Library

New Hampshire Roentgen Ray Society
Secretary, Dr. A. C. Johnston, Elliott Community Hospital, Keene, N. H. Meets four to six times yearly.

Radiological Society of New Jersey
Secretary, Dr. W. H. Seward, Orange Memorial Hospital, Orange, N. J. Meets annually at time and place of State Medical Society. Mid-year meetings at place chosen by president.

New York Roentgen Society
Secretary, Dr. Ramsay Spillman, 115 East 61st St., New York City. Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

North Carolina Radiological Society
Secretary, Dr. J. E. Hemphill, 323 Professional Bldg., Charlotte 2, N. C. Meets in May and October.

North Dakota Radiological Society
Secretary, Dr. L. A. Nash, St. John's Hospital, Fargo. Meetings held by announcement.

Central New York Roentgen Ray Society
Secretary, Dr. C. F. Potter, 820 S. Crouse Ave., Syracuse. Three meetings a year. January, May, November.

Ohio Radiological Society
Secretary, Dr. Henry Snow, 1061 Reibold Bldg., Dayton, Ohio. Meets during annual meeting of Ohio State Medical Association.

Oklahoma State Radiological Society
Secretary, Dr. P. E. Russo, 230 Osler Bldg., Oklahoma City, Okla. Three regular meetings annually.

Orleans Parish Radiological Society
Secretary, Dr. Joseph V. Schlosser, Charity Hospital, New Orleans 13, La. Meets first Tuesday of each month.

Pacific Roentgen Society
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

Pennsylvania Radiological Society
Secretary, Dr. J. M. Converse, 416 Pine St., Williamsport.

Philadelphia Roentgen Ray Society
Secretary, Dr. C. L. Stewart, Jefferson Hospital. Meets first Thursday of each month, October to May, at 8:00 P.M., in Thomson Hall, College of Physicians.

Pittsburgh Roentgen Society
Secretary, Dr. L. M. J. Freedman, 115 South Highland Ave. Meets 6:30 P.M. at Webster Hall Hotel on second Wednesday each month, October to May inclusive.

Portland Roentgen Club
Secretary, Dr. Selma Hyman, University of Oregon Medical School, Portland, Oregon. Meets monthly 2d Wednesday, 8:00 P.M., Library of University of Oregon Medical School.

Rochester Roentgen Ray Society, Rochester, N. Y.
Secretary, Dr. Murray P. George, Strong Memorial Hospital. Meets monthly on third Monday from October to May, inclusive, 8 P.M. at Strong Memorial Hospital.

Rocky Mountain Radiological Society
Secretary Dr. A. M. Popma, 220 N. First St., Boise, Idaho.

St. Louis Society of Radiologists
Secretary, Dr. Edwin C. Ernst, Beaumont Medical Building, St. Louis, Mo. Meets fourth Wednesday of each month, except June, July, August, and September.

San Diego Roentgen Society
Secretary, Dr. R. F. Niehaus, 1831 Fourth Ave., San Diego, Calif. Meets monthly, first Wednesday at dinner.

San Francisco Radiological Society
Secretary, Dr. Joseph Levitin, 516 Sutter St., San Francisco 2, Calif. Meets monthly on the third Thursday at 7:45 P.M., first six months of the year at Lane Hall, Stanford University Hospital, and second six months at Toland Hall, University of California Hospital.

Shreveport Radiological Club
Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

South Carolina X-Ray Society
Secretary, Dr. T. A. Pitts, Baptist Hospital, Columbia, S. C. Meets in Charleston on first Thursday in November, also at the time and place of South Carolina State Medical Association.

Tennessee Radiological Society
Secretary, Dr. J. M. Frère, 707 Walnut St., Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary, Dr. R. P. O'Bannon, 650 Fifth Ave., Fort Worth 4, Texas.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

University of Wisconsin Radiological Conference
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets first and third Thursdays 4:00 to 5:00 P.M., September to May inclusive. Room 203, Service Memorial Institute, 426 N. Charter St., Madison.

Utah Radiological Conference
Secretary, Dr. Henry H. Lerner, School of Medicine, University of Utah, Salt Lake City 1. Meets 1st and 3rd Thursdays monthly from 7:30 to 10 P.M., Salt Lake County General Hospital, September to June.

Utah State Radiological Society
Secretary, Dr. M. Lowry Allen, Judge Bldg., Salt Lake City 1, Utah. Meets third Wednesday in September, November, January, March and May.

Virginia Radiological Society
Secretary, Dr. E. L. Flanagan, 116 E. Franklin St. Richmond, Va. Meets annually in October.

Washington State Radiological Society
Secretary, Dr. Thomas Carlile, 1115 Terry St., Seattle. Meets fourth Monday each month, October through May, College Club, Seattle.

X-Ray Study Club of San Francisco
Secretary, Dr. J. M. Robinson, University of California Hospital. Meets monthly, third Thursday evening.

Cuba

Sociedad de Radiología y Fisioterapia de Cuba
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

Mexico

Sociedad Mexicana de Radiologia y Fisioterapia
General Secretary, Dr. D. P. Cossio, Marsella No. 11, Mexico, D. F. Meets first Monday of each month.

British Empire

British Institute of Radiology Incorporated with the Roentgen Society
Medical Members' meeting held monthly on third Friday at 2:30 P.M. and Ordinary Meeting at same time on following Saturday, October to May, 32 Welbeck St., London, W.1.

Section of Radiology of the Royal Society of Medicine (Confined to Medical Members)
Meets third Friday each month at 4:45 P.M. at the Royal Society of Medicine, 1 Wimpole St., London.

Faculty of Radiologists
Secretary, Dr. M. H. Jupe, 23 Welbeck St., London, W.1 England.

Section of Radiology and Medical Electricity, Australasian Medical Congress
Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Radiological Section of the Victorian Branch of the British Medical Association
Secretary, Dr. Keith Hallam, St. George's Hospital,

K.E.W., Melbourne, E. 4, Victoria, Australia. Meets monthly from March to November inclusive.

CANADIAN ASSOCIATION OF RADIOLOGISTS
Honorary Secretary, Dr. E. M. Crawford, 2100 Marlowe Ave., Montreal 28, Que. Meetings January and June.

SOCIÉTÉ CANADIENNE-FRANCAISE D'ÉLECTROLOGIE ET DE RADIOLOGIE MÉDICALES
Secretary, Dr. Origéne Dufresne, 4120 Ontario St., East, Montreal, P. Q.

SECTION OF RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Anderson, Invercargill, New Zealand. Meets annually.

SOUTH AMERICA

SOCIEDAD ARGENTINA DE RADIOLOGIA
Secretary, Dr. Guido Gotta, Buenos Aires, Argentina. Meetings are held monthly.

SOCIEDAD PERUANA DE RADIOLOGIA
Secretary, Dr. Julio Bedoya Paredes, Apartado, 2306 Lima, Peru. Meetings held monthly except during January, February and March, at the Asociación Médica Peruana "Daniel A. Carrión," Villalta, 218, Lima.

CONTINENTAL EUROPE

SOCIÉTÉ BELGE DE RADIOLOGIE
General Secretary, Dr. S. Masy, 111 Avenue des Alliés, Louvain, Belgium. Meets monthly, second Sunday at Maison des Médecins, Brussels.

CESKOSLOVENSKÁ SPOLEČNOST PRO RÖNTGENOLOGII A RADIOLOGII V PRAZE
Secretary: MUDr. Roman Blána, Praha XII, Korunní 160, Czechoslovakia.

SOCIEDAD ESPANOLA DE RADIOLOGIA Y ELECTROLOGIA
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

SOCIÉTÉ SUISSE DE RADIOLOGIE (SCHWEIZERISCHE RÖNTGEN-GESELLSCHAFT)
Secretary for French language, Dr. Babaiantz, Geneva.
Secretary for German language, Dr. Max Hopf, Effingerstrasse 49, Bern. Meets annually in different cities.

SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE
Secretary, Dr. Oscar Meller, Str. Banual Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD: USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin. Meets monthly, first Monday at 8 o'clock, State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky. Meets monthly, first Monday, 8 P.M.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

AUSTRALIAN AND NEW ZEALAND ASSOCIATION OF RADIOLOGISTS

The first issue of a "Newsletter" issued by the Australian and New Zealand Association of Radiologists contains many items of interest. A Council Meeting was held in Melbourne on August 17, 1946. Representatives from all the States and Tasmania were present, except West Australia, travel from there offering difficulties. Matters having to do with Articles of Association and of qualification for membership were discussed.

A meeting of the Education Committee was also held in Melbourne at this time. The main item of discussion was the Diploma of Radiology. At present two courses are being given by the Universities of Melbourne and Sydney. Both these courses are of a high standard and are indicative of good work and a high degree of efficiency, but they vary as to syllabus and different subjects are included in the curricula. The main requirements from the point of diagnostic and therapeutic qualification are much the same. The Education Committee, however, considered that a uniformity of standard with reference to both the subjects included and the requirements of the examiners would be desirable. There was much discussion and several subcommittees were appointed for the furtherance of these ideas.

A plan for an improved roentgenological service in Australia was submitted for consideration by the Council and all members. This was appreciated and contained much that may be a basis of the future of radiology in Australia.

The main social event was the dinner given in honor of Dr. Herbert Maunsell Hewlett. This was to mark the completion of fifty years in the practice of radiology by Dr. Hewlett. Many messages of congratulation were received from those not in attendance at the dinner. A number of toasts were given with a response by Dr. Hewlett and a portrait of Dr. Hewlett was presented to the Association. Dr. Hewlett began his work in radiology in 1896 and it was said by one of the speakers that during all the years of his practice he never for one moment had lost the clinical and pathological approach to roentgenological interpretation and it was this clear concept

of clinical background of diagnostic roentgenology which had been the basis of Dr. Hewlett's success over so long a professional span. It was said that no radiologist in Australia had done more to develop and to maintain the prestige of radiology as a medical specialty, and this happy gathering of his colleagues from various parts of the Commonwealth, met to express their gratitude and appreciation of fifty years given to this specialty, set the seal on a long and splendid professional career.

CANADIAN ASSOCIATION OF RADIOLOGISTS

The Tenth Midwinter Meeting of the Canadian Association of Radiologists was held in Quebec, Canada, on January 3, 4 and 5, 1947, under the presidency of Dr. C. W. Prowd of Vancouver. Among the papers given during the three day session were the following:

Friedländer Bacillus in Pulmonary Disease, by Dr. Dso-Li-Lang and Dr. C. B. Peirce, Montreal.

Adult Ileocecal Intussusception with Report of a Case, by Dr. M. R. Dickey, Vancouver.

Gastric Conditions, by Dr. J. J. Porter and Dr. D. G. Florentine, Calgary.

Roentgenological Localization of Ureteral Obstruction Caused by Non-radiopaque or Undistinguishable Calculi, by Dr. G. Gill, Montreal.

Rectilinear Planigraphy, by Dr. D. T. Burke, Toronto.

Brochongenic Carcinoma, by Dr. W. L. Sloan, Vancouver.

Lipiodol Injection of the Bronchial Tree through the Cricothyroid Membrane, by Dr. R. L. Smith, Halifax.

Tomographic Study of the Chest, by Dr. E. F. Crutchlow, Montreal.

Apical Bronchiectasis, by Dr. W. J. Cryderman, Toronto.

Esophageal Hiatus Hernia, by Dr. J. Stapleton, Hamilton.

Observations on Gastric Carcinoma in its Earliest Stages, by Dr. A. Vallée, Montreal.

Roentgenological Findings in Raynaud's Disease, by Dr. C. E. Vaughan, Hamilton.

Tendinitis Calcarea, Bursitis and Periarthritis about the Shoulder; Selection of Cases for Radiation Therapy and their Management, by Dr. G. I. Norton, Dr. Alan McCurrach and Dr. J. Bouchard, Montreal.

Radiation Sickness, by Dr. O. W. Millar and Dr. A. W. Heath, Toronto.

Present Status of Cephalopelvimetry, by Dr. C. L. Ash and Dr. K. F. MacEwen, Toronto.

Roentgenological Studies of the Small Intestine, by Dr. W. Light, Montreal.

Skin Therapy Experiences in the Canadian Army Overseas, by Dr. J. Sommers, Toronto.

Roentgen Management of Intrathoracic Neoplasm, by Dr. W. E. Crysler, Toronto.

Tuberculous tracheobronchitis, by Dr. A. C. Singleton and Dr. J. J. Barry, Toronto.

Spot Film Roentgenography in Gastric Work, including a Reference to the Use of the Photoelectric Timer in that Work, by Dr. J. D. Roger, Ottawa.

The Radiologist in a Small Community, by Dr. W. B. Parsons, Red Deer.

Spondylolisthesis, by Dr. R. F. Keevil, Toronto.

Spondylolisthesis, by Dr. R. Vallée, Montreal.

Calcinosis, by Dr. L. Tremblay and Dr. J. E. Perron, Quebec.

Lymphoepithelioma of the Nasopharynx; Roentgen Therapy and Management, by Dr. A. M. Edington and Dr. J. Bouchard, Montreal.

Thoraco-abdominal Neoplasm with Discussion of Diagnostic Methods, by Dr. J. C. Robitaille and Dr. E. C. Brooks, Montreal.

Pneumocranium, by Dr. D. C. Eaglesham, Toronto.

Diverticula of the Gastrointestinal Tract, by Dr. A. D. Bracken, Montreal.

Osteochondrosis, by Dr. N. L. Hillary, Toronto.

Calcifications Occurring in Paraplegics, by Dr. A. J. Andrews, Toronto.

Henoch's Purpura Showing Intestinal Changes Radiologically, by Dr. W. A. Jones, Kingston.

A Case Study of Bone Changes in a Rib and Associated Vertebrae, by Dr. K. C. Falkner, St. Thomas.

Diverticula of the Small Intestine, by Dr. S. R. Bennett, Sarnia.

Metastatic Carcinoma of the Spine, Primary in the Breast, by Dr. R. D. Nash, Kingston.

Roentgen and Radium Therapy of a Submaxillary Reticulo-sarcoma, by Dr. P. A. Simard, Montreal.

Gaucher's Disease, by Dr. P. E. Coté, Quebec.

LAURISTON S. TAYLOR AWARDED MEDAL OF FREEDOM

The following news item appeared in *Science*, January 3, 1947, page 8:

Lauriston S. Taylor, chief of the X-Ray Section, National Bureau of Standards, has been awarded the Medal of Freedom for work on improved methods of bombing and bombing accuracy in the European theater, the Bureau of Standards has announced. At the same time Mr. Taylor received the Bronze Star Medal for "outstanding leadership, analytical ability, and technical skill in prosecution of the war." As chief of the Operational Research Section of the Ninth Air Force, Mr. Taylor headed a civilian group of scientists in work on bombing accuracy, selection of bombs and fuses, radar, radar countermeasures, selection methods for lead crews, and blind bombing.

Mr. Taylor joined the Bureau in 1927 and became chief of the X-Ray Section in 1941. Prior to service in Europe he was active in development of the radio proximity fuse.

NOTICE TO APPLICANTS AND DIPLOMATES OF THE AMERICAN BOARD OF RADIOLOGY

There are many Diplomates and candidates with applications on file whom we are unable to reach from their last known address. During and since the war many Radiologists have changed locations and now have a different address than appears in the records of the Board kept in the Secretary's office.

It is very important that these records be accurate and it is therefore urged that all those Diplomates whose present address is different from that which appears in the new Third Edition of "The Directory of Medical Specialists," and all applicants whose address has changed since they filed their application, notify the Secretary immediately.

B. R. Kirklin, M.D., *Secretary*
American Board of Radiology
Mayo Clinic, Rochester, Minnesota

POLISH SOCIETY OF RADIOLOGY

The Polish Society of Radiology has again resumed its activities. The first postwar inaugural meeting will be held in Warsaw on May 22 and 23, 1947.

The Warsaw Section of the Polish Society of Radiology has been active since February, 1946 and this section meets monthly. The President of the Warsaw Section of the Polish Society of Radiology is Prof. W. Zawadowski, Aleja Wojska 3, Warsaw, and the Secretary is Dr. L. Zgliczynski, Nowogrodzka 59 Warsaw.

BOOK REVIEWS

Books sent for review are acknowledged under: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interest of our readers as space permits.

THE RESULTS OF RADIUM AND X-RAY THERAPY IN MALIGNANT DISEASE. Second Statistical Report from The Holt Radium Institute, Manchester, 1934–1938. Compiled by Ralston Paterson, Margaret Tod and Marion Russell. Paper. Price, 7s 6d. Pp. 147. Edinburgh: E. & S. Livingstone, Ltd., 1946.

The first Statistical Report from the Holt Radium Institute under the directorship of Dr. Paterson was published in 1939 and covered the years of 1932 and 1933. At that time only one roentgen apparatus was available so that the cases were treated almost exclusively with radium. The results given in the first report, therefore, were radium results and any comparisons made were between various ways of using radium.

In 1933 the Institute and Christie Hospital moved to large new buildings and the roentgen irradiation facilities were greatly expanded. Eventually four 250 kv. tubes were put in operation and these were followed, in 1940, by a fifth designed to run at 500 kv. This development led to a constant increase in the number of patients treated by means of roentgen rays although the radium, too, was used extensively.

In this second Statistical Report an analysis of the five year results in the cases treated between 1934 and 1938 with both radium and roentgen rays is given. It is quite remarkable that during the entire war the treatment of cancer and the follow-up of cancer patients have continued as the authors state "almost uninterrupted in an island described by Mr. Winston Churchill as this embattled fortress."

The present report is divided into three large parts: I. General survey of the treatment of malignant diseases; II. Evaluation of different methods of treatment, and III. Ten year analysis of cases published in the first report.

A total of 9,130 patients suffering from malignant disease were seen at the Institute during the five years mentioned, 6,380 of which received treatment. Broadly, the distribution and the net five year survival rate of the various groups were as follows: (1) cancer of skin: 1,803 cases, 88 per cent survival; (2) cancer of mouth and lip: 1,289 cases, 30 per cent survival; (3) cancer of breast: 863 cases, 20 per cent survival; (4) cancer of uterine cervix: 826 cases, 28 per-cent survival; (5) cancer of uterine body: 91 cases, 26 per cent survival; (6) cancer of pharynx and larynx: 321 cases, 12 per cent survival; (7) cancer of maxillary antrum: 75 cases, 25 per cent survival; (8) cancer of rectum: 106 cases, 8 per cent survival; (9) cancer of bladder: 95 cases, 31 per cent survival, and (10) miscellaneous: 911 cases, with a survival rate varying from 0 to 85 per cent.

The net five year survival rate for all 6,380 cases was 40 per cent. By taking into consideration the stage of advancement of the disease, the following figures were obtained: I. 87 per cent (1,727 cases); II. 45 per cent (1,862 cases); III. 21 per cent (881 cases); IV. 7 per cent (1,722 cases) and unclassified 188 cases.

The net ten year survival rate of the cases analyzed in the first report was 39 per cent as compared with the over-all net survival rate of 41 per cent at five years.

As a whole, this statistical compilation of the results in such large number of cases is extremely valuable. The authors painstakingly analyzed all possible phases of the subject and give interesting data concerning the best methods of clinical application to be followed. The various technical procedures are also indicated and if they could not be described fully, a bibliography of the relevant publications is supplied. A textbook on "The Treatment of Malignant Disease by Radium and X-ray" is in press and will appear shortly.

T. LEUCUTIA

RADIUM THERAPY: ITS PHYSICAL ASPECTS. By C. W. Wilson, M.Sc., Ph.D., F. Inst. P., Physicist in the Department of X-Ray and Radium Therapy, Westminster Hospital. Cardboard. Price, 18s. Pp. 224, with 97 illustrations. London: Chapman and Hall, Ltd., 1945.

This book supplies an excellent practical survey of the physical aspects of radium therapy, more complete and detailed than anything hitherto available. The basic theories of radio-

activity are passed over rather briefly, but the interaction of high energy radiations with matter are discussed in detail. In gamma-ray dosimetry, particular attention is paid to the development and employment of the air-wall chamber. A number of circuits are given for practical dosimetry with electrometer tubes as indicators.

A large part of the book is devoted to dosage calculations, with many examples. For surface therapy, the Paterson and Parker method is followed. In cavitary therapy, various systems for treatment of cancer of the cervix are compared—Paris, Stockholm, Manchester. In interstitial dosage calculations the Memorial Hospital and Paterson and Parker techniques are discussed, with numerous examples for the latter. A chapter devoted to dosage in teleradium therapy will find fewer readers in America, since this method is now little used here. The matter of protection is adequately covered.

To each of the eight chapters is appended a good list of references, specific and general. The first group elaborate upon points made in the text, and are particularly useful to the student interested in a particular part of the problem.

One might wish that more attention had been devoted to the matter of integral dose, or total energy absorption by the patient, since the British have gone quite thoroughly into this important subject, which is just beginning to be appreciated in the United States.

A need has long been felt for such a book. It has been recognized in this country that often it is more difficult to obtain basic preparation for radium than for roentgen therapy, as well as practical experience. No book can provide or substitute for experience, but this one can contribute materially to basic information. It should be welcomed by students, teachers, and all practicing radiologists and radium therapists.

Edith H. Quimby

Experimental Investigations of the Effects of Roentgen Rays on the Eye. By Erik Poppe. From the General Department of the Norwegian Radium Hospital, Oslo (Chief: Rulf Bull Engelstad, M.D.) and the Hospital's Laboratory for Pathology (Former Chief: Leiv Kreyberg, M.D., Present Chief: Reidar Eker, M.D.) Paper. Price, Kr. 14.00. Pp. 102, with 12 text figures and 15 plates. Oslo: I Kommisjon Hos Jacob Dybwad, 1942.

Until 1929 experiments on animals, which had been undertaken to determine the action of roentgen rays on the eye, had shown that, in the eyes of young rapidly growing animals, the crystalline lens was exceptionally sensitive to roentgen rays and that even a small dose of rays could induce the formation of cataract. The only other structures which were perceptibly affected were the retina, of which one layer (the internal granular layer) was retarded in its development, and the development of the eyeball as a whole also was retarded more or less according to the dose of rays. As for the other ocular structures, the only one which was affected by doses of rays within the therapeutic range was the conjunctiva and the skin of the lids. The latter had been found to be somewhat more sensitive (15 to 20 per cent more) than the skin of the face in general. In the eyes of adults, however, similar doses of rays had not produced perceptible alterations in the crystalline lens, in the retina, or in the eye as a whole, except in the conjunctiva and eyelids.

In 1929, 1930 and 1936 further experiments carried out by Rohrschneider, Peter, Leinfelder and Kerr, and by others, had shown that, in animals at least, the crystalline lens of the adult eye is distinctly more sensitive than had been indicated by the earlier investigations, and that the formation of cataract could be induced by doses of 890 roentgens (Rohrschneider—188 kv., 3 mm. of aluminium or 0.5 mm. copper and 3 mm. of aluminium); 100 per cent S.E.D. (Peter); 600 r (Leinfelder and Kerr—200 kv., 0.5 mm. copper and 1 mm. aluminium).

This latest series of experiments by Poppe is extremely valuable and important, because it shows conclusively that the crystalline lens of adult rabbits is even more sensitive to roentgen rays than any of the earlier investigations had indicated; that a dose of 250 roentgens (175 kv., 0.5 mm. copper and 1 mm. aluminium), when given at one time, can induce minimal, but not progressive, cataractous changes in the lens; that a dose of 500 r (same quality of rays) can induce slight, clinically recognizable, but not progressive, cataractous changes in the lens; that a dose of 900 r (same quality of rays) induced similar, but more marked, changes in the lens; that after doses of 1,000 to 1,300 r, not only were the lenticular opacities more pronounced, but complete epilation and conjunctivitis also developed; that doses of 1,500 r produced complete epilation and persistent pathologic changes in the conjunctiva and

cornea of all the irradiated rabbits—changes which could be recognized clinically and histologically—and pronounced and progressive opacification of the lens. Poppe's observations indicate that the slow, but progressive, increase in cataract formation after large doses of rays appears to be due to irreparable injury to the lenticular epithelium. After daily, fractional doses of 150 to 500 r (total dose, 400 to 2,500 r), similar but somewhat less marked changes in the hair follicles, conjunctiva, cornea, and lens were observed, but the recuperative power of hair follicles, conjunctiva, and cornea, was considerably greater than that of the crystalline lens. Fractional doses, when given at intervals of five days (3×100 r), sometimes repeated six weeks later (3×150 r), or even after 5 animals received a third series (3×100 r) at the same interval of five days (total dose, 1,050 r in four months), produced still less pronounced changes in the lens, (stage 1 cataract), but no clinical or histological changes were observed in the other ocular structures.

This is by far the most thorough and painstaking investigation of the action of roentgen rays on the different structures of the eye of adult animals which has yet been carried out. How closely Poppe's findings can be applied to human beings remains to be determined.

Arthur U. Desjardins

Roentgen Diagnosis of Diseases of the Gastrointestinal Tract. By John T. Farrell, Jr., M.D., Clinical Professor of Radiology, Graduate School of Medicine, University of Pennsylvania; Radiologist, The Lankenau Hospital, Children's Hospital of the Mary J. Drexel Home; Roentgenologist, White Haven Sanatorium; Consulting Roentgenologist, Frederick Douglas Memorial Hospital, Mercy Hospital. Cloth. Price, $5.50. Pp. 271, with 190 illustrations. Springfield, Illinois: Charles C Thomas, 1946.

This little volume, as the author points out, should be considered as an outline of Diseases of the Alimentary Canal. As such, it should prove quite helpful.

The description of the various techniques is excellent, but it is believed that the book would be of still more value if indications for variations in the routine procedures were discussed more fully. For example, an excellent description of the technique and of the roentgenologic findings in polyposis of the colon is given. The indication for the rather time-consuming procedure of insufflation, however, is not stressed, namely, passage of bright red blood by bowel.

The warnings of the dangers of roentgenoscopy are very timely, for far too many patients and untrained physicians are injured by radiation while doing roentgenoscopy.

One of the striking omissions is a complete lack of bibliography. Undoubtedly the author omitted this with "malice aforethought," but in an outline such as this volume aimed primarily at the "occasional radiologist," readily found references dealing more exhaustively with various diseases would prove very helpful.

Noticeable, also, is the omission of several conditions not infrequently encountered such as amebiasis, internal hernia of the small bowel, prolapse of the gastric mucosa into the duodenum, pyloric stenosis of adults, etc.

As a whole, this book is well worth while as an outline, but it is felt that the summaries following each section might be deleted and this space used more advantageously along the lines suggested above.

Dr. Farrell has done well in calling attention to and using the Standard Nomenclature of Disease. Radiologists as a whole are a little too loose in terminology, and may profit by following the author's example.

The illustrations are excellent, and the author is to be congratulated on his selection, and the publisher upon the reproductions.

Vincent W. Archer

Radiumdosimetrie. By Dr. Phil. Walter Minder, Technischer Leiter des Institutes der Bernischen Radiumstiftung in Bern. Cloth. Price, $5.50. Pp. 183, with 97 illustrations. Wien: Julius Springer, 1941. J. W. Edwards, Publisher, Ann Arbor, Michigan.

This book summarizes most of the essential facts in the correlation of the physical aspects of the determination of dosage of radium and the radioactive substances with their medical applications. The presentation is essentially physical and mathematical; the purely medical aspects of radium therapy are treated only sketchily. The book may serve as an introduction to the dosage of radium for the German-reading therapist to whom other sources of such information are unavailable. Readers of English may find this material more conveniently elsewhere.

E. T. Leddy

Wm. Beaumont's Formative Years: Two Early Notebooks 1811–1821. With Annotations and an Introductory Essay. By Genevieve Miller, M.A., Institute of the History of Medicine, The Johns Hopkins University. Cloth. Price, $6.00. Pp. 128, with 24 illustrations. New York: Henry Schuman, 1946.

American medicine is justly proud of William Beaumont and his work "Experiments and Observations on the Gastric Juice and the Physiology of Digestion." Medicine in this country has not only been colored by but its character has been formed by the contributions and achievements of our pioneer physicians. While medicine in the schools was fixed and often sterile due to slavish following of the orthodox, physicians on the frontier, without benefit of consultation and urged by necessity, developed from their own ingenuity many important advances. Not the least of these was Beaumont's investigation of human digestion carried on in most romantic and historically interesting circumstances well known to most of us. Beaumont was a man of great force and charm. We know a great deal about him because he kept diaries, not only one but two. The first was a record of his professional life, case histories, favorite prescriptions and scholarly comments. The second was his personal record of events, thoughts, favorite bits of poetry, and philosophical observations full of interest to those who would know the man himself. These notebooks are in the possession of the Washington University College of Medicine, St. Louis, Missouri. They have been published in part elsewhere, notably in Meyer's Life and Letters of Dr. William Beaumont, but until now they have not been available in their completeness to all of us. Miss Genevieve Miller has prepared them for publication with pertinent scholarly notations and explanations in a very pleasing form. Her introduction is a charming commentary on Beaumont's life and work. The book is attractive in print, binding and illustrations.

Anyone interested in the early history of our country should own the book. It gives an insight into education, the development of science, medical practice and historical events fresh from the mind of a keen observer, a good American, and our original and greatest contributor to the physiology of digestion. The author and the publisher deserve our thanks.

F. A. Coller

Ergebnisse der biophysikalischen Forschung. Band I: Ultrakurzwellen. Edited by B. Rajewsky. Published and distributed in the Public Interest by Authority of the Alien Property Custodian under License No. A-285. Pp. 308, with 188 illustrations and 24 tables. Leipzig: Georg Thieme, 1938.

This is the first volume of a series of monographs prepared under the editorship of Rajewsky and appearing under the title of "Results of Biophysical Research." In the introduction the author outlines very briefly the historical aspect of short and ultrashort electric waves. The first chapter, written by Schaefer (Frankfurt a. M.), contains the physical and technical principles; it is illustrated by simple diagrams and also some mathematical formulas which should not be too difficult to interpret for the medical reader. In the next chapter Rajewsky discusses the biophysical principles of the effect of ultrashort waves on living tissue; this part is of special interest to the biologist, who will find some valuable experimental data in the text. A theory of the behavior and reaction of biological media is outlined by Danzer in the third chapter; it is rather mathematical and its profitable perusal requires some knowledge of calculus. The more important problems involving the exposure of biological specimens to the ultrashort waves are related by Hollmann (Berlin). He deals with the distribution of radiant energy in conducting media, the effect of the thickness of the tissue layer on the energy distribution and with methods offering some possibilities of increasing the dose in the depth. The last chapter is a practical one and prepared by Schliephake, who is one of the pioneer investigators of the clinical application of short wave diathermy on the continent. His presentation is conservative and gives an excellent résumé of the field for the physician. He stresses the fact that although good progress has been made in the medical use of short electric waves, short wave diathermy is by no means a cure-all. The literature up to 1938 is covered in the bibliographies attached to the various chapters.

Ernst A. Pohle

BOOKS RECEIVED

The Normal Encephalogram. By Leo M. Davidoff, M.D., Professor of Clinical Neurological Surgery in the College of Physicians and Surgeons, Columbia University; Attend-

ing Neurological Surgeon to the Montefiore Hospital, New York City, and Cornelius G. Dyke, M.D., Late Associate Professor of Radiology in the College of Physicians and Surgeons, Columbia University; Late Director, in the Department of Radiology of the Neurological Institute of New York, New York City. Second edition, thoroughly revised. Cloth. Price, $5.50. Pp. 232, with 155 illustrations. Philadelphia: Lea & Febiger, 1946.

THE CHEST: A HANDBOOK OF ROENTGEN DIAGNOSIS. By Leo G. Rigler, M.D., Professor and Chief, Department of Radiology, University of Minnesota. Cloth. Price, $6.50. Pp. 352, with 388 illustrations. Chicago: Year Book Publishers, Inc., 1946.

PRINCIPLES IN ROENTGEN STUDY OF THE CHEST. By William Snow, M.D., Director of Radiology, Bronx Hospital; Roentgenologist-in-charge, Harlem Hospital, New York City. Cloth. Price, $10.00. Pp. 141, with 508 illustrations. Springfield, Illinois: Charles C. Thomas, 1946.

PRÉCIS DE RADIO-DIAGNOSTIC. Par le Docteur P. Van Pée, Professeur à l'Université de Liége. Paper. Pp. 382, with 214 figures and 62 plates. Paris: Masson et Cie, 1944.

GASTROENTEROLOGY IN GENERAL PRACTICE. By Louis Pelner, M.D., Associate Attending Physician, Greenpoint Hospital, Brooklyn, New York; Associate Visiting Physician, Brooklyn Cancer Institute; Adjunct Physician, Beth Moses Hospital, Brooklyn, New York. With the Collaboration of: Louis A. Held, M.D., Attending Roentgenologist, Beth Moses Hospital, Brooklyn, New York. Cloth. Price, $7.50. Pp. 285, with 107 illustrations (20 color plates). Springfield, Illinois: Charles C Thomas, 1946.

PEPTIC ULCER: ITS DIAGNOSIS AND TREATMENT. By I. W. Held, M.D., F.A.C.P., Attending Physician, Beth Israel Hospital; Clinical Professor of Medicine (Retired), New York University, College of Medicine, New York City, and A. Allen Goldbloom, M.D., F.A.C.P., Assistant Clinical Professor of Medicine, New York Medical College and Flower-Fifth Avenue Hospital; Associate Physician, Beth Israel and Metropolitan Hospitals; Associate Cardiologist, Beth Israel Hospital, New York City. Cloth. Price, $6.50. Pp. 382, with 110 illustrations. Springfield, Illinois: Charles C Thomas, 1946.

UROLOGIC ROENTGENOLOGY. By Miley B. Wesson, M.D., Ex-President American Urological Association. Second edition, thoroughly revised. Cloth. Price, $5.50. Pp. 259, with 258 illustrations. Philadelphia: Lea & Febiger, 1946.

THE PRINCIPLES OF NEUROLOGICAL SURGERY. By Loyal Davis, M.S., M.D., Ph.D., D.Sc. (Hon.), Professor of Surgery and Chairman of the Division of Surgery, Northwestern University Medical School, Chicago, Illinois. Third edition, thoroughly revised. Cloth. Price, $7.50. Pp. 540, with 192 engravings, containing 348 illustrations and 5 plates, 4 in color. Philadelphia: Lea & Febiger, 1946.

THE RESULTS OF RADIUM AND X-RAY THERAPY IN MALIGNANT DISEASE. Second Statistical Report from The Holt Radium Institute, Manchester, 1934–1938. Compiled by Ralston Paterson, Margaret Tod and Marion Russell. Paper. Price, 7s 6d. Pp. 147. Edinburgh: E. & S. Livingstone, Ltd, 1946.

THE X-RAY TREATMENT OF ACCESSIBLE CANCER. By D. Waldron Smithers, M.D., D.M.R., Director of the Radiotherapy Departments The Royal Cancer Hospital (Free) and the Royal Free Hospital; Radiotherapist Brompton Hospital for Diseases of the Chest; Associate Physician for Radiotherapy, West End Hospital for Nervous Diseases, etc. Cloth. Price, $8.50. Pp. 147, with 102 illustrations. Baltimore: The Williams & Wilkins Company, 1946.

LE FIBRO-MYOME UTÉRIN. Par J. Ducuing, Professeur de Clinique chirurgicale à la Faculté de Médecine de Toulouse; Directeur du Centre Anticancéreux. Paper. Pp. 541, with 156 illustrations. Paris: Masson et Cie, 1946.

RADIUM THERAPY: ITS PHYSICAL ASPECTS. By C. W. Wilson, M.Sc., Ph.D., F.Inst.P., Physicist in the Department of X-Ray and Radium Therapy, Westminster Hospital. Cardboard. Price, 18s. Pp. 224, with 97 illustrations. London: Chapman and Hall, Ltd, 1945.

X-RAYS IN PRACTICE. By Wayne T. Sproull, Ph.D., Physicist, Research Laboratories Division, General Motors Corporation. Cloth. Price, $6.00. Pp. 615, with numerous illustrations. New York: McGraw-Hill Book Company, Inc., 1946.

RADIUM LOST AND FOUND. By Robert B. Taft, M.D., B.S., M.A., F.A.C.R. Second edition. With an introduction by George E. Pfahler, M.D., Sc.D., LL.D., D.M.R.E.(Camb.), F.A.C.R. Cloth. Pp. 158, with illustrations

by Mercedes Hoshall, B.F.A. Charleston, S. C.: Walker, Evans & Cogswell Co., 1946.

Queensland Radium Institute. Second Annual Report of the Honourable the Minister for Health and Home Affairs. For the Year ended 30th June, 1946. Pp. 23.

Experimental Investigations of the Effects of Roentgen Rays on the Eye. By Erik Poppe. From the General Department of the Norwegian Radium Hospital, Oslo (Chief: Rolf Bull Engelstad, M.D.) and the Hospital's Laboratory for Pathology (Former Chief: Leiv Kreyberg, M.D., Present Chief: Reidar Eker, M.D.). Paper. Price, Kr, 14.00. Pp. 102, with 12 text figures and 15 plates. Oslo: I Kimmisjon Hos Jacob Dybwad, 1942.

Medical Research: A Symposium. Edited by Austin Smith, M.D. Cloth. Price, $5.00. Pp. 169, with 17 illustrations, including 10 in color. Philadelphia: J. B. Lippincott Company, 1946.

Harvey Cushing: A Biography. By John F. Fulton. Cloth. Price, $5.00. Pp. 754, with 150 illustrations. Springfield, Illinois: Charles C Thomas, 1946.

Wm. Beaumont's Formative Years: Two Early Notebooks 1811-1821. With Annotations and an Introductory Essay. By Genevieve Miller, M.A., Institute of the History of Medicine, The Johns Hopkins University. Cloth. Price, $6.00. Pp. 128, with 24 illustrations. New York: Henry Schuman, 1946.

Victory Over Pain: A History of Anesthesia. By Victor Robinson, M.D. Cloth. Price, $3.50. Pp. 338, with numerous illustrations. New York: Henry Schuman, 1946.

A Memoir to the Academy of Sciences at Paris on a New Use of Sulphuric Ether. By W. T. G. Morton of Boston in the U.S.A. Presented by M. Arago in the Autumn of 1847. Paper. Price, $1.50. Pp. 24. New York: Henry Schuman, 1946.

The Centennial of Surgical Anesthesia: An Annotated Catalogue of Books and Pamphlets Bearing on the Early History of Surgical Anesthesia. Compiled by John F. Fulton, M.D., and Madeline E. Stanton, A.B. Paper. Price, $4.00. Pp. 102, with illustrations. New York: Henry Schuman, 1946.

Journal of the History of Medicine and Allied Sciences. Vol. 1, No. 4, 1946. Anesthesia Centennial Number. Paper, Price, $2.50. Pp. 505–710, with illustrations. New York: Henry Schuman, 1946.

DEPARTMENT OF TECHNIQUE

Department Editor: Robert B. Taft, M.D., B.S., M.A., 103 Rutledge Ave.
Charleston, S. C.

A DEVICE FOR SINUS ROENTGENOGRAPHY WITH HORIZONTAL RAYS

By CESARE GIANTURCO, M.D.
Carle Hospital Clinic
URBANA, ILLINOIS

IN ORDER to demonstrate fluid levels in the sinuses it is necessary to use horizontal rays, but most sinus boards are designed for vertical rays and are not easily adaptable to horizontal roentgenography.

In the past six months I have employed a device which is simple and which satisfies the requirements of the most exacting technique. The device (Fig. 1) consists of a standard 3 inch cone at the end of which are attached two curved arms. At the ends of these arms is hinged a 5 by 7 inch cassette holder. Two wing nuts allow variation of the angle of the holder to the central ray. The front of the cassette holder is made of plexiglass so that one may observe the face of the patient through it. A cross engraved on the plexiglass eases the centering procedure. The device is mounted on the tube like an ordinary cone. The tube is then turned so that the central ray is horizontal and is made fast to the tube stand. This gives the sinus device a very rigid support. The patient stands with his buttocks against one end of the table, then the device is positioned so that with the holder at a 23° angle the patient places his nose and forehead on the plexiglass front. The root of the nose is centered with the center of the cross. The 5 by 7 inch cassette is then inserted in the holder and the exposure is made. This film is for the frontal sinuses. Without changing the angle of the cassette holder, the patient is then asked to place his nose and chin (mouth open) on the plexiglass front, and the center of the

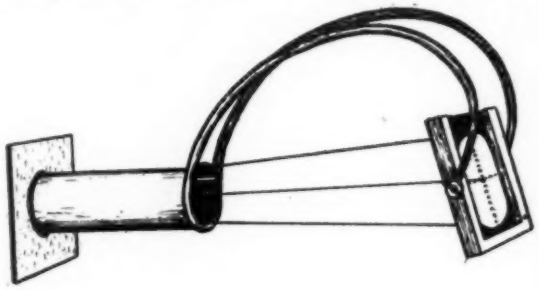

Fig. 1

cross is centered to the junction of the nose and upper lip. This is the position for the maxillary sinuses. Lateral views can be taken after placing the cassette holder perpendicular to the central ray.

The device is also useful for other views of the skull. Mastoids in the Law and Stenvers position, optic foramina, atlas and axis, temporomandibular joints can be easily centered through the transparent plexiglass after making suitable changes in the angle of the holder.

Carle Hospital Clinic
Urbana, Ill.

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ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

HEAD

Morgan, J. E. Calcification in cephalhematomata of the newborn infant. *Am. J. Obst. & Gynec.*, Nov., 1944, *48*, 702–705.

Cephalhematomata of the newborn infant are localized collections of blood beneath the periosteum of one of the bones of the cranial vault. They may be single or multiple. The entire periosteum covering that particular cranial bone is elevated.

The lesions themselves are not particularly dangerous, but since they are more common after difficult labors, babies presenting them bear most careful watching. The swelling appears the first or second day after delivery, and usually absorbs rapidly after the first week of life. Most of them are completely absorbed by the third week. Unfortunately, all of them do not go away. A very appreciable number calcify, forming a more or less permanent deforming lump on the child's head.

Pathogenesis of Calcification in Cephalhematomata. The hematoma is sharply delineated by the margins of the particular bone which it happens to overly because the periosteum is adherent to the bone at its margin. If one of the lesions does not absorb rapidly, subperiosteal osteogenesis begins at the attached margin of periosteum all around the circumference of the bone. If absorption of the clot is completed at this time, the newly formed bone can be felt as a slight ridge or elevation around the edge of the skull plate. This gives a false sensation that the central portion of this particular bone is depressed and can be mistaken for a depressed skull fracture.

If, however, absorption of the clot does not proceed rapidly, the newly formed bone at the edge grows subperiosteally up over the dome of the bulge until at one stage only a small area at the apex of the lesion lacks a bony covering. Shortly, this is also filled in, and the hematoma is completely roofed over with a thin pliable layer of bone. This bony covering rapidly becomes thicker and more solid until in a few weeks it clinically seems as firm as the remainder of the skull. There is now a hard bony protuberance which persists for an indefinite length of time. As the child grows, the protrusion seems to tend to flatten and merge into the general contour of the skull, but it is an extremely slow process. Dr. S. J. Webster followed one lesion which persisted for more than twenty years. Therefore, while the tendency may be toward spontaneous cure it can certainly be slow.

Treatment. In the lesions which are not absorbing rapidly at the end of two weeks, aspiration is advised. A needle with a fairly large bore is used. The contents have liquefied by this time so that from 10 to 40 cc. of thick bloody fluid can readily be withdrawn.—*Mary Frances Vastine.*

Cooperstock, M. Leptomeningeal cyst associated with hemiplegia and skull defect of traumatic origin. *J. Pediat.*, April, 1946, *28*, 488–492.

Leptomeningeal cysts usually follow severe head trauma with comminuted or depressed skull fractures. They result from tear of the arachnoid, pia mater, and often dura mater. According to Dyke, areas of subarachnoid space become separated from the general subarachnoid space during the subsequent healing process and cystic collections of fluid develop. The pulsating pressure of the brain is transmitted to the skull through these cystic collections and this results in the bony defects. The neurologic changes are due to actual cortical destruction.

The author reports a case of a child who sustained a fracture of the right parietal bone at the age of five months. Her convalescence was rapid from the injury and no evidence of cranial nerve injury or pathological reflexes were found. A soft swelling which was noted over the fracture site at the time of injury gradually decreased in size over a two year period. The mass showed increased tension when the child cried, indicating its communication with the ventricular system. Weakness of the left arm and leg was noted six months after the accident. After the child began to walk a typically hemiplegic gait was present. The swelling over the right parietal area gradually disappeared and left a

large palpable bony defect in the skull. More than ten years after the original injury an operation was performed which revealed leptomeningeal cysts with underlying cortical destruction.

The original skull roentgenograms showed a linear fracture of the right parietal bone without apparent depression. Films four months later showed a large area of bone absorption consisting of circumscribed areas of rarefaction with slight marginal sclerosis. Subsequent films revealed a persistent failure of closure of the defect. The author concludes that skull fracture plus hemiplegia should indicate severe craniocerebral; injury conducive to formation of leptomeningeal cysts and indicate early operation. Roentgen evidence of bone absorption is confirmatory.—*R. M. Harvey.*

Law, Frederick M. Stereoscopic versus plain films in accessory sinus examinations. *Ann. Otol., Rhin., & Laryng.*, Sept., 1944, *53*, 531–535.

Roentgenography of the nasal accessory sinuses is the most difficult of the many branches, and requires the most painstaking care in the technique. A poorly made set of films is worse than useless. There must be a sufficient number of films made in various angles. Many times, the author has had films referred for interpretation to find that there are only two films. Such a set is of no value whatever.

There are three methods for this examination: (1) plain or flat films; (2) stereoscopic films; (3) sectional or planigraphic films. The most generally satisfactory examination is with stereoscopic films. It is possible to so train the eyes that stereoscopic vision can be obtained without the use of any extra equipment. It is very simple and when once understood, requires little practice to obtain a good third dimensional impression.

In a few cases, the planigraph is valuable in sinus work. It is indispensable in the examination of the larynx in the posterior anterior position as it removes the image of the spine and shows the extent of involvement of the soft tissues of the larynx.

Stereoscopic films will give added information in the following instances:

1. In all cases of fracture of the skull.

2. In all cases of fracture of the nasal bones. They enable one to see which side is fractured and how much displacement exists.

3. In cases in which the film taken in the Waters position shows an apparent tumor in the antrum. A stereoscopic film may show this tumor to be due to the image of the cheek or upper lip superimposed on the antrum.

4. In cases in which the film taken in the Waters position is negative, while the film taken in the 23 degree angle position is positive. A stereoscopic film may show this opacity to be due to an increased density of the floor of the posterior cranial fossa, which will be placed posterior to the antrum.

5. In cases in which it is difficult to determine whether the right or left ethmoid shows a change in the appearance of the cell structure as viewed on the lateral film.

6. In cases in which it is difficult to determine on which side a large agger cell exists.

7. In all cases of enlargement of the sella turcica.

8. In all cases of bony involvement of the skull.

9. In cases in which there is a suspicion of absence of a frontal sinus or a four plus involvement of a frontal as indicated by a faint circular line of density where the superior border of the frontal should be. A stereoscopic film may show this line to be part of the occipital suture superimposed on the frontal region, and not the superior border of the frontal, thus proving the absence of a frontal sinus.

10. In cases in which the lateral film shows a suspicion of a partition dividing the antrum into two sections. A stereoscopic film will prove this apparent partition to be the posterior border of the malar bone.

11. In all cases for examination of the petrous pyramid.

12. In all cases for examination for salivary calculus.

13. In cases in which an apparent soft tissue tumor is shown on lateral films of the pharynx. A stereoscopic film may show this to be caused by the lobe of the ear and to be entirely outside the skull, not in the pharynx.

14. In cases of malignancy involving the antra. The stereoscopic film enables one to determine more accurately the degree of bony involvement.

There is one precaution to be observed when examining each one of a stereoscopic pair of posterior anterior views of the sinuses as separate plain films. The necessary shift in the position of the tube may cause one antrum to be more opaque than the other. This opacity may

be manifest in both views but on opposite sides. The stereoscope will fuse them both and give a true image. If a stereoscope is not used, then the condition of both antra must be considered to be registered by the lesser opacity. The increased density is caused by the angulation of the tube and shifts as the tube is modified to one side or the other. If one or both antra are badly involved, this precaution does not follow.

The author demonstrates the method of obtaining third dimensional impression by means of a diagram and directions for fusing the two images (stereoscopic) in the diagram (i.e., without the use of a stereoscope).—*Mary Frances Vastine.*

Neuhauser, E. B. D., and Ferris, B. G., Jr. The treatment of acute suppurative parotitis in infants. *J. Pediat.*, 1945, *27*, 589–590.

Small doses of roentgen radiation is the accepted treatment of acute suppurative parotitis in adults. Sanford and Shmigelsky, in 1945, reporting on the same condition in infants, concluded that oral sulfathiazole and surgical intervention was the treatment of choice. The authors report their results in 3 cases of acute suppurative parotitis in the newborn and 1 case complicating a staphylococcal septicemia. Their cases were treated by consecutive daily roentgen irradiation for two to three days plus sulfadiazine. In all cases the parotid involvement disappeared in two to six days without recurrence. This is a much faster recovery rate than that reported by Sanford and Shmigelsky following surgery plus chemotherapy. Their average recovery time varied from two to three weeks and their cases were faced with the possibility of a deforming scar or a parotid fistula.

The technique employed by Newhauser and Ferris was to administer 125 roentgens to the affected parotid glands using 125 kv., 5 ma., 3 mm. aluminum filter, and 15 inch target-skin distance with a half-value layer of 4.6 mm. of aluminum. This dose is repeated the second day and, if necessary, the third day.—*R. M. Harvey.*

NECK AND CHEST

Szanto, Paul B., and Hollender, A. R. Tuberculosis of the nasopharynx. *Ann. Otol., Rhin. & Laryng.*, Sept., 1944, *53*, 508–521.

Tuberculosis of the nasopharynx is only meagerly described in textbooks on pathology and otolaryngology. Its frequent incidence and relationship to pulmonary tuberculosis render it a problem meriting more serious consideration. This study is based on the pathologic investigation of 134 autopsy specimens of the pharynx.

There were 24 subjects with various forms of tuberculosis in the series comprising the material for this work. The nasopharynx was involved in 18 specimens (75 per cent). Gross lesions were visible in 14 instances, while in 4 the lesions were detected only by microscopic examination.

Summary and Conclusions.

1. The common sites of tuberculous lesions of the nasopharynx are the posterior part of the roof and the upper part of the posterior wall. Less frequent sites are the posterior margin of the ostia of the eustachian tubes and the nasopharyngeal surface of the uvula and soft palate.

2. The gross pathologic changes are characterized by irregular ulcers, mostly ovoid in shape with undermined margins and yellowish-gray bases. There are two types of tuberculosis of the nasopharynx: (1) the open ulcerous, and (2) the closed (grossly invisible). Obviously, unless microscopic study is resorted to in all instances, one frequently will fail in diagnosis of the closed type.

3. While the authors' data do not permit them to state that the nasopharynx may be a primary site of tuberculous infection, they are convinced of the frequency with which this organ may become involved in the course of pulmonary tuberculosis.

4. The pathogenesis of tuberculosis of the nasopharynx may be explained on the same theory as tuberculous disease of the intestines—inoculation of the mucous membrane by contact with sputum containing tubercle bacilli. This perhaps accounts also for the localization of ulcers, in most cases, on the posterior part of the roof and on the posterior wall of the nasopharynx.

5. While the deep inferior cervical lymph nodes showed the usual enlargement, such a change was not observed in relation to the superior cervical and the retropharyngeal lymph nodes.

6. In the 2 cases of miliary tuberculosis, the pharynx was negative for tuberculosis. This would seem to favor the view that infection by the hematogenous route is rare.

7. In a number of the specimens the nasopharyngeal and the tubal tonsils showed a partial or complete involution. The presence or absence of tuberculosis of the nasopharynx is

independent of the developmental stage of the nasopharyngeal lymphatic tissue.

8. None of the specimens displayed any microscopic evidence of tuberculous involvement of the middle ear, despite the presence of tuberculous ulcers around the ostia of the eustachian tubes.

9. Tuberculous disease of the nasopharynx in the course of fibrotic tuberculosis of the lungs is of more practical significance than the frequent incidence of tuberculosis of the nasopharynx in far-advanced fibrocaseous ulcerative tuberculosis of the lungs. It is not far fetched to assume that the nasopharynx may be the persistent source of reinfection of the lungs. Furthermore, it is not an unlikely source of a positive sputum in arrested pulmonary tuberculous disease.

10. These studies emphatically demonstrate the value of a clinical investigation of the nasopharynx in all routine physical examinations, especially in persons with pulmonary tuberculosis. Certainly, an examination of this organ is quite as important as that of the larynx. In the absence of other findings an obscure focus may often prove to be present in the nasopharyngeal cavity.—*Mary Frances Vastine.*

LIERLE, D. M. Congenital lymphangiomatous macroglossia with cystic hygroma of the neck. *Ann. Otol., Rhin. & Laryng.*, Sept., 1944, *53*, 574–575.

Cystic hygroma may be congenital or acquired. Its origin frequently is in the submaxillary region, and it may involve the face, the floor of the mouth, and the tongue. The essential pathology consists of a dilatation of the lymphatic spaces. This dilatation is due to obstruction caused by the absence of efferent lymph vessels, or by lymphatics which do not have patent channels. Sich believes that the origin of lymphangiomas is in an isolated vessel or a connective tissue primitive rest which perforates into new lymph vessels. The hygroma usually consists of multilocular cysts lined with endothelium with fibromuscular walls. These cysts are usually translucent and contain lymph fluid, but they also may have milky or chocolate-colored fluid with cholesterin.

Sections of the tongue in lymphangiomatous macroglossia reveal excess fibrous tissue, lymph vessels surrounded by enlarged vessels containing coagulated blood and lymphadenomatous new growth.

The cases in the author's series were 3 girls, eleven months, two and three years old, respectively. All had varying degrees of macroglossia at birth. Two had associated cystic hygroma of the neck at birth.

Two of the cases are receiving treatment at the present time and in the third case, the treatment consisted of surgical removal of the tumor of the neck. This appeared to arise from the left submaxillary region. It involved the floor of the mouth and extended into the base of the tongue. Since roentgen treatment in angiomata causes swelling of the endothelial cells and a degeneration of the elastic fibers and muscle with a replacement by fibrous tissue, the tongue was treated with divided doses of roentgen rays. A total of about 3,000 roentgens, divided into doses of 400 to 500 r, was used over a period of about four months. For only a short time, there was a definite decrease in the size of the tongue. Later it increased somewhat in size. A plastic operation was then done on the tongue. The anterior portion was amputated. Microscopic sections revealed the absence of lymph spaces, but there was degeneration of muscle with replacement by a large amount of fibrous tissue. There has been no recurrence in a period of four years.—*Mary Frances Vastine.*

TAYLOR, H. MARSHALL. Ventricular laryngocele. *Ann. Otol., Rhin. & Laryng.*, Sept., 1944, *53*, 536–543.

Galen first made mention of the laryngeal ventricle in 300 A.D. Recognition of this recess was credited to him by Morgagni, who gave an incomplete description of it in 1741 and for whom it is named. Larrey, the French army surgeon, first mentioned the air sac which at times develops from the saccus of this ventricle. The term, laryngocele, now commonly applied to this anomaly, was introduced in 1867 by Virchow.

The proper clinical conception of laryngocele in man is dependent in large measure upon adequate understanding of the evolution and physiologic aspects of the ventricle of Morgagni. This portion of the larynx is a horizontal space, elliptical in shape. It is situated between the true and the false vocal cords. Anteriorly from the roof there arises a vertical pouch known anatomically as the sacculus.

There is a close resemblance between the larynx of mammals and that of reptiles and birds. One striking difference, however, is that the ventricle is observed only in mammalian

life. The human larynx was not originally designed to serve as an organ of speech, but instead was primarily intended as a valve for guarding the pulmonary system at its entrance by exercising the primitive function of keeping everything out of the lungs but air. Negus concluded that air sacs are not developed for purposes of voice and noted that many animals without them are as noisy or more so than those with them. Among the examples he cited are the roar of the lion, which has no air sacs, and the seldom heard voice of the Anubis baboon with its enormous air cavities.

As viewed by the author, the structure of the larynx in the different mammals differs in accordance with the relative quantity of oxygen needed and of carbon dioxide given off by the lungs. This requirement is influenced by the mode of life. Compensation for the interruption of the vital function of normal respiration (for example in anthropoid apes, cessation of respiration involved in fixation of chest required to give pectoral muscles full play as forelimbs grasp, hug, strike, and climb) was attained by the evolution of air sacs arising from the ventricle of the larynx. They serve as mixing chambers for oxygen and/or carbon dioxide and are used with the least amount of exertion by the lungs.

It would appear that the sacculus, which is a constant finding in man, is a degenerated relic of air sacs leading out of the ventricle. Lindsay described three types of laryngocele: (1) the internal laryngocele is a cystic dilatation in which the hernial protrusion of the mucous membrane lies within the larynx; (2) the superior external laryngocele appears as a swelling in the neck after the sac has perforated and projects as a hernia through the thyrohyoid membrane; (3) the internal and external laryngocele may occur in combination joined by a small isthmus.

A pre-existing pathologic condition is not necessary to the development of a laryngocele for the condition is observed in the normal larynx.

Diagnosis: An external swelling of the neck with convexity of the ventricular band, some decrease of this mass on pressure accompanied by a hissing sound, and the presence of a tympanitic note on percussion should establish a clinical diagnosis which may readily be confirmed by roentgenograms showing a sac filled with air.—*Mary Frances Vastine.*

Kohn, Jerome L., Schwartz, Irving, Greenbaum, J., and Daly, M.M.I. Roentgenograms of the chest taken during pertussis. *Am. J. Dis. Child.*, June, 1944, *67*, 463–468.

In this paper a report is given of a study of successive roentgenograms of the chest in 222 children between the ages of five months and eight years during the course of pertussis. The roentgenograms were exposed in the posteroanterior position and also, whenever possible, in the right direct lateral position.

The patients were divided into three groups: those with no fever, those with low grade fever and those with high fever during the course of the infection. Roentgenograms of some patients in all three groups showed no abnormality, while those of others showed increased pulmonary markings, pulmonary infiltration or both. Pulmonary involvement occurred in mild, moderate and severe illnesses. Pulmonary consolidation and severe symptoms were more frequent when fever was present.

Roentgenograms taken in the lateral position often revealed a homogeneous shadow in the area of the middle lobe of the right lung, interpreted as being due to atelectasis. Later, this area resumed its normal markings. Physical examination over the involved lobe gave little indication of the change noted in the roentgenogram. The authors believe that frequent involvement of the middle lobe of the right lung in pertussis may be due to the viscous nature of the secretion and the narrow width of the middle lobe bronchus.

In the posteroanterior views, the most frequent site of pulmonary consolidation was the area of the cardiohepatic angle. Contrary to previous reports, roentgen evidence of enlarged tracheobronchial lymph nodes was infrequent.—*R. S. Bromer.*

Cooperstock, M. Atelectasis complicating acute poliomyelitis with involvement of respiratory muscles. *Am. J. Dis. Child.*, June, 1944, *67*, 457–462.

Cooperstock states that in poliomyelitis with involvement of the respiratory muscles there exists a constant threat of the sequential development of bronchostenosis, atelectasis and secondary pneumonia, primarily due to the presence of predisposing factors of diminished vital capacity of the lungs and impaired efficiency of the cough mechanism. This threat of serious pulmonary complications becomes im-

minent with the occurrence of infection of the respiratory tract.

Of 4 patients with atelectasis complicating poliomyelitis with paralysis of the muscles of respiration 3 recovered. He believes the favorable outcome in these patients followed the occurrence of a critical clinical picture, undoubtedly due to the development of secondary pneumonia. Recovery appeared to be due to the favorable effect of treatment with sulfonamide compounds on the pneumonic process which permitted ultimate spontaneous clearing of the atelectasis.

Cooperstock advocates the early use of chemotherapy to prevent the development of serious complications and considers the continued use of the mechanical respirator in cases of early infection of the respiratory tract essential. Bronchoscopy may also be useful in the early stages of the infection as relief of bronchial occlusion may minimize pulmonary complications. He thinks it is of unusual interest that in patients already so seriously handicapped by poliomyelitis spontaneous clearing of atelectasis is possible.

The article is illustrated with roentgenograms of the lungs of the 4 cases reported.—*R. S. Bromer.*

Leopold, Jerome S., and Kratzman, Emil A. Obstructive pulmonary emphysema associated with pneumonia in childhood. *Am. J. Dis. Child.*, May, 1945, *69*, 287–290.

Regional obstructive pulmonary emphysema in children following an acute infection of the upper respiratory tract has only recently been recognized as a clinical entity. The diagnosis of the condition is made on the characteristic roentgenographic picture, the clinical course and the absence of physical signs. The roentgenographic appearance is typical, especially when the pulmonary fields are clear. The emphysematous area consists of an abnormal region of decreased density, which is surrounded by a thin, dense yet smooth, margin. The area is usually ovoid, but it is occasionally spheroid and sometimes loculated. It varies from very small to extremely large size and it may occupy a large portion of the pulmonary field. A characteristic feature is the variation in size of the lesion that occurs from time to time. The duration of the lesion is usually a matter of weeks, but occasionally it may be months before the pulmonary fields become normal. The cavity may contain fluid.

The authors report 2 cases including illustrations of roentgenograms showing the development and final disappearance of the emphysematous areas. They state the differential diagnosis is easily made if the case is closely followed. Differentiation must be made from congenital lung cysts, localized pneumothorax cavities, cavitation due to tuberculosis and diaphragmatic hernia. Congenital lung cysts in the early stages are usually solid fluid cysts. Later when the fluid is replaced by air the cyst wall is usually seen as rather thin capsule. Fluoroscopic examination may reveal an increase in illumination within the cyst during inspiration. It is stated that pulmonary cysts are always in communication with the outside air while in obstructive emphysema there is no direct communication between an emphysematous area and a bronchus.

The mechanism that produces the localized obstructive pulmonary emphysema is satisfactorily explained by a "check valve" type of obstruction. During pneumonia conditions favorable to obstruction of the collateral circulation of air and to a "check valve" obstruction of a bronchus are present. The entrapped air causes an emphysematous reaction, and because of the presence of an inflammatory exudate in the alveolar spaces, the air is unable to escape. Eventual resolution probably occurs by means of slow diffusion of air through the margin of the area or by removal of the initial obstruction.—*R. S. Bromer.*

Smith, Richard H. Primary atypical pneumonia, etiology unknown; average clinical picture based on thirty-seven original cases. *Ann. Int. Med.*, June, 1944, *20*, 890–902.

The authors report a study of 37 cases. Of these, 34 had a prodomal cold. The onset was not severe. Only one case had pleuritic pain, although many complained of substernal soreness. Three cases began with chills. Two cases had slightly blood-streaked sputum.

The highest temperature was usually noted on the first or second day in the hospital. Many fevers were irregular. The maximum temperature ranged from 100 to 105.2°F. Average maximum was 102 to 103°F.

Much emphasis has been laid on the absence or scarcity of physical signs as an important point in differentiating primary atypical pneumonia from pneumococcal pneumonia. In the experience of the writer this is true only insofar as signs of frank consolidation usually were

absent. The extent of the lesion disclosed by roentgenogram was greater than that anticipated on physical examination.

It is believed that the roentgenographic findings in primary atypical pneumonia are not pathognomic. Any portion of the lungs may be involved. Shadows vary in size and differ in character from patchy to diffuse to mixed. Rarely does the density occupy an entire lobe. Often it occupies portions of adjoining lobes.—*James J. McCort.*

Denenholz, Edward J., and Cheney, Garnett. Diagnosis and treatment of chronic coccidioidomycosis. *Arch. Int. Med.*, Nov., 1944, *74*, 311–330.

The basis for this report consists of observation of 14 patients proved to have clinical coccidioidomycosis and of 30 patients for whom the diagnosis was proposed but not confirmed. The authors believe that there is no early roentgen evidence that is pathognomonic of coccidioidal infection and point out also that in some primary coccidioidal infections no pulmonary changes may be demonstrable by roentgen examinations.

A characteristic but not pathognomonic roentgen evidence of chronic coccidiodal infection is the presence of a solitary, thin-walled, balloon-like cavity with little or no surrounding reaction. A striking feature is the tendency for the cavity to persist despite regression of other associated pulmonary lesions. The primary coccidioidal cavity is perhaps most common in the upper lobe, though it may occur anywhere in the lung. Winn has emphasized that such a large thin-walled cavity may be of mechanical origin.

The most common pulmonary roentgen evidences of disseminated coccidioidomycosis are marked progressive pulmonary consolidation and infiltration and miliary dissemination. Mediastinal adenopathy is also pointed out as a frequent outstanding characteristic of coccidioidal infection of this type and attention is directed to its ominous prognostic significance. There may be cystlike, sharply circumscribed osteolytic lesions in the bones with little reaction surrounding them. The lesions may be multiple and are especially apt to occur in cancellous bone.

Medical treatment usually has better effect on this disease and the primary consideration of therapy is rest in bed to aid focalization of the infection.—*James J. McCort.*

Sussman, M. L., and Grishman, A. The value of roentgenologic examination of the heart. *Am. Heart J.*, Nov., 1944, *28*, 647–660.

The authors are of the opinion that precision measurement of the individual chambers of the heart cannot be attained but that experience results in a certain visual dexterity in the contours between certain fixed points when correlated with body habitus, the position of the diaphragm and the size of the heart as a whole. As an aid in the evalutation of these contours, the writers present an analysis of the cardiac contour in the normal subject and in those diseases in which there is predominant enlargement of a single chamber. This analysis is based largely on angiocardiographic studies confirmed in most instances by postmortem correlation.

In cor pulmonale where there is predominant enlargement of the right ventricle, the heart is found to be widened mainly to the left in the posteroanterior view and there is a prominence of the pulmonary artery segment of the middle left contour. Enlargement of the heart to the right does not appear ordinarily until there is frank right-sided heart failure.

Mitral stenosis gives rise to a predominant dilatation of the left auricle. Roentgenographically it is characterized by a straightening or convexity of the middle left cardiac contour in the posteroanterior and right oblique positions. The left main bronchus may be elevated. The esophagus is displaced posteriorly, as well as to the right and is compressed.

Left ventricular enlargement may take the form of concentric hypertrophy, with little or no dilatation (usually associated with hypertension), or eccentric hypertrophy with dilatation. The roentgenologic diagnosis of concentric hypertrophy is made with difficulty. Until there is a sufficient increase in the volume of the heart, which does not occur with concentric hypertrophy alone, the roentgenologic diagnosis must be based on the shape of the left ventricular contour. This becomes rounded as seen in the posteroanterior view or somewhat better in the left anterior oblique position.—*James J. McCort.*

Lindsay, Stuart. The heart in primary systemic amyloidosis. *Am. Heart J.*, Oct., 1946, *32*, 419–437.

This study is based on one case report and a review of the literature. The patient was a white woman, aged fifty-nine, who complained of exertional dyspnea, weakness, edema of the

ankles, and substernal pain on exertion. The physical examination disclosed a soft systolic murmur in the mitral and aortic areas, occasional ventricular extrasystoles, and a blood pressure of 95/60. Fluoroscopic examination of the chest showed a diffuse cardiac enlargement involving mainly the left ventricle and auricle. The cardiac contractions were poor and at the apex of the left ventricle almost absent. The hilar shadows were widened.

During the course of the illness a serosanguineous pleural effusion appeared on the right, and the dyspnea, thoracic pain and edema increased. There were increasing signs of congestive heart failure unimproved by the usual measures, and the patient died one year after the onset of the cardiac symptoms.

The autopsy revealed effusions in the peritoneal cavity and both pleural cavities. The heart weighed 500 grams and all portions of the myocardium were unusually firm with a pale brownish-tan color. A strong solution of iodine stained the myocardium diffusely, producing a mahogany-brown color and indicating amyloid deposit. Amyloid deposits were also found in the spleen, the stomach, and the lower esophagus. Microscopically the amyloid deposits in the heart were intercellular sometimes enclosing and compressing the myocardial fibers and were most marked in the left ventricle.

Amyloid is composed of two protein fractions and one polysaccharide fraction. Amyloid disease may be (1) secondary, (2) primary, (3) associated with multiple myeloma, or (4) produced by tumor. Forty-four cases of primary systemic amyloidosis have been reported in the literature and of these, 23 showed evidence of cardiac failure and 39 showed amyloid deposition in the heart at autopsy. Skin lesions are fairly common and are accessible for diagnostic biopsy. The Congo red test was positive in only 5 of 10 patients. Therapy with liver substance may be of value.—*Wm. A. Evans.*

Rogers, H. Milton. Bilateral pulmonary infarction and pneumothorax complicating hypertensive, coronary heart disease with myocardial infarction. *Am. Heart J.*, Oct., 1946, *32*, 519–528.

Spontaneous pneumothorax has been reported in tuberculosis, pneumonia, asthma and mediastinal emphysema. Marks reported its association with pulmonary infarction in 1940. The author reports the case of a white male, aged forty-four, complaining of dyspnea and cough who four weeks previously had been seized with severe substernal pain. He had had hypertension for ten years. An electrocardiogram indicated an anterior myocardial infarction. Roentgenographic studies showed mottled shadows in both lung fields, more marked on the right, with a circular density in the area of the right middle lobe. The transverse diameter of the thorax and heart were 31 cm. and 16 cm. A week later there was fever, more severe cough, and more pain in the right side of the chest and at this time a bilateral pneumothorax was discovered by roentgen examination in addition to severe passive congestion and infarctions in the lung fields. There was clinical improvement and at an examination sixteen days later there had been complete resolution of the pneumothorax on both sides and of the pulmonary infarctions. The heart had decreased in size and the passive congestion had improved. Death occurred, however, in a subsequent attack of cardiac failure 130 days after the first examination.

At autopsy the heart weighed 600 grams. There was an aneurysm in the anterior apical region at the site of the old infarction, a bilateral pleural effusion, atelectasis of the right lower lobe which contained an old infarct, and several smaller infarcts in both lungs.

Marks points out that pneumothorax is more likely to occur in pulmonary infarctions if the infarcts are septic but such was not the fact in the author's case. The author believes that the pneumothorax occurred from rupture of the pulmonary alveoli during paroxysms of coughing induced by the pulmonary infarctions. The bilateral occurrence of the pneumothorax is evidence in favor of mediastinal emphysema preceding the pneumothorax.—*Wm. A. Evans.*

Borman, Milton C. Calcification of left ventricular infarction recognized during life. *Ann. Int. Med.*, May, 1943, *18*, 857–866.

In this patient roentgenographic studies and fluoroscopic examinations showed vascular pulmonary engorgement. The heart was enlarged to the left and the left portion of the heart including the apex and lower third of the left border was occupied by a dense ring-like shadow, which formed an oblong ring. The vertical diameter of this ring was 10.5 cm., transverse diameter was 8 cm. and 0.5 cm. in thickness. This was well visualized in Bucky roentgenograms in posteroanterior, anteroposterior, and right oblique positions. It was

definitely established that the deposit of calcium extended to the edge of the lower left portion of the heart. In the lateral position the shadow had the appearance of a quarter moon. The aorta was elongated, the knob prominent to the left. It was believed from these findings that the ring-like shadow was probably calcium deposit in an old infarct following coronary occlusion and was in the parietal wall of the left ventricle.

Fourteen months later death took place. At post mortem examination the only noteworthy finding was the condition of the heart. The anterior surface of the left ventricle had a firmly rounded, bulging appearance, involving the lower half of the left ventricle and the apex was about 10 cm. in diameter and separated from the upper portion of the left ventricle by a faintly visible and palpable groove. On palpation this bulging portion felt like bone and extended around the apex and along the posterior wall of the left ventricle for about 2 cm. When the left ventricle was opened, it was seen that the area disclosed on the external aspect of the left ventricle corresponded to the wall of an aneurysmal dilatation varying from 7 to 14 mm. in thickness. Embedded in the wall between the layers of scar tissue and remnants of myocardium were plaques of calcification some of which seemed to be ossified. Microscopic examination showed recanalization of old occlusions in the vessels, with intramural plaques of calcification frequently surrounded by remnants of scar tissue and myocardium in the wall of the aneurysm. In other areas definite bone formation could be demonstrated.—*James J. McCort.*

Finkelstein, David, and Klainer, Max J. Pericarditis associated with primary atypical pneumonia. *Am. Heart J.*, Sept., 1944, *28*, 385–394.

This is a report of 3 cases of pericarditis of unknown etiology. In all 3 patients there was found to have been an antecedent or concomitant primary atypical pneumonia.

It is thought probable by the authors that the etiologic agent responsible for the atypical primary pneumonia is also the cause of the associated pericarditis. Throat cultures, sputum examinations, and typing and blood cultures did not reveal any specific bacterial organisms. Studies were carried out at the Army Medical Museum on blood samples from these patients to ascertain whether the virus of psittacosis, Q fever, or lymphocytic choriomeningitis was present. The results were negative. The presence of a pericardial friction rub in 2 of these cases and the absence of clinical or roentgenologic evidence of pericardial effusion suggests that the pericarditis was fibrinous in nature. Although in 1 case the cardiac silhouette, as visualized roentgenographically, did increase in size, its configuration and the symptoms and signs did not suggest pericardial effusion.—*James J. McCort.*

Young, Dennison, and Schwedel, John B. The heart in rheumatoid arthritis. *Am. Heart J.*, July, 1944, *28*, 1–23.

In this paper are presented the postmortem and related clinical data in 38 cases of rheumatoid arthritis in adults. In 33 of these cases there were cardiac lesions which were not the result of hypertension or coronary artery disease. All patients included in this material suffered from an inflammatory polyarticular process which was progressive in character and resulted in deformity and disability.

In 25 of the 33 cases (65.7 per cent) showing cardiac lesions the process was considered to be rheumatic in origin and of a nonspecific infectious nature in the remaining 8 cases. An active rheumatic process was present in only 6 cases. A history of rheumatic fever was obtained in only 3 cases and of probably rheumatic fever in 2 others. In 18 patients the arthritis was insidious and progressive and in 15, acute attacks of polyarthritis occurred during the course of the disease. The extremely high incidence of rheumatic heart disease in rheumatoid arthritis which was found in this and previous pathologic studies suggests an extremely close relationship which should lead to consideration of the possibility that they may be manifestations of the underlying same disease process.—*James J. McCort.*

Kerwin, A. J. Observations on the heart size of natives living at high altitudes. *Am. Heart J.*, July, 1944, *28*, 69–80.

The subjects for this study were normal native Peruvian males of Indian race with a small admixture of white blood in some cases. All had been born at altitudes varying from 10,000 to 15,000 feet and with a few exceptions had lived all their lives at these altitudes. Some had made trips to lower levels or even to the sea coast, but usually not for more than a few months. These men were either applying for work in the smelter or mines or were anxious to leave the

company employ. Roentgenograms of the chest were utilized in an attempt to ascertain whether living at a high altitude does cause cardiac enlargement.

As judged by the transverse diameter and frontal area, the size of the cardiac silhouette was definitely greater in these people than in normal white inhabitants of low altitudes. The average increase in transverse diameter was 11.5 per cent and in frontal area 16.3 per cent. In the age group studies no progressive enlargement with increasing age was evident.

It is suggested that this may be one of a variety of adaptive changes which occur with prolonged exposure to low concentrations of oxygen.—*James J. McCort.*

Loewenberg, S.A., and Baer, S. Aneurysm of the descending thoracic aorta. *Am. Heart J.*, Nov., 1946, *32*, 653–658.

Aortic aneurysms are usually reported as involving the arch, the thoracic aorta and the abdominal aorta. Involvement of the descending thoracic aorta is the least common.

The authors report the case of a Negro, aged sixty-one, who complained of abdominal pain during an illness which began with weakness, malaise and cough. The Wassermann reaction was positive. During the roentgen study of the gastrointestinal tract it was observed that the lower esophagus was displaced anteriorly and to the left by a mass lying anteriorly and to the right of the spine. The mass appeared continuous with the descending aorta, and the examination of the spine showed erosion of the ninth and tenth dorsal vertebrae on the right. The patient died in a severe paroxysm of coughing with a profuse hemoptysis.

At autopsy a large saccular aneurysm was found in the descending aorta just above the diaphragm. It extended into the left pleural cavity and had ruptured into the adjacent lung. The heart appeared normal. A probe passed through the bronchus of the lower lobe entered the area at the base where the aneurysm had ruptured into the lung.

The authors conclude that the anatomic relation of the esophagus to the aorta is of extreme importance in diagnosing the lesion. Normally the upper thoracic aorta occupies a position anterior and to the left of the esophagus. As the aorta and esophagus pass through the hiatus of the diaphragm, the esophagus crosses over the aorta. In the majority of the aortic aneurysms the esophagus is displaced posteriorly and to the right. An aortic aneurysm at the hiatus displaces the esophagus anteriorly and to the left.—*Wm. A. Evans.*

Master, Arthur M. Right-sided aorta with atypical coarctation involving only the left subclavian artery. Hypertension. *Am. Heart J.*, Dec., 1946, *32*, 778–785.

The author reports the case of a male, aged twenty-two, without symptoms rejected for a commission in the Navy because of hypertension. A short systolic murmur was heard at the base of the heart. The heart rate was slow and the left radial pulse was weaker than the right. The blood pressure measurements were: Left arm, 104–124/70–80; right arm, 158–170/60–76; right thigh 200/100; left thigh, 200/90. A roentgenogram failed to show any erosion of the ribs by dilated intercostal arteries but did reveal a right-sided aortic arch and this was confirmed fluoroscopically when the barium-filled esophagus was seen displaced anteriorly and to the left of the aorta. Angiocardiographic studies were then made under the direction of Dr. Marcy Sussman. Diodrast was observed clearly in the aorta, in the right innominate, and in the left carotid arteries. There was no sign of the left subclavian artery and it was concluded that this vessel was atresic. The aorta appeared normal.

When the left radial pulse is small, such conditions as a large cervical rib, a high backward position of the shoulder, an anatomic variation in the course of the radial artery, an aortic aneurysm and a tumor compressing the subclavian artery are to be considered before the diagnosis of coarctation of the left subclavian artery is entertained. This hypertension in the right arm is considered as a systemic response of the arterioles to constriction of a large branch of the aorta.—*Wm. A. Evans.*

Perlman, Lawrence. Coarctation of the aorta; clinical and roentgenologic analysis of thirteen cases. *Am. Heart J.*, July, 1944, *28*, 24–38.

From the clinical standpoint the authors found that absence of the femoral pulsations, the presence of intercostal pulsations and the presence of a basal diastolic murmur were the most frequent findings.

Although the diagnosis of coarctation may be made clinically the roentgenogram is a very

definite diagnostic aid. The roentgenologic syndrome is said to consist of:

1. The absence of the aortic knob.
2. Dilatation of the ascending and transverse portions of the aorta.
3. Erosion of the lower margin of the posterior portions of the ribs.
4. Roundness or enlargement of the left ventricle.

In this series of cases the only constant roentgenologic signs were absence of the aortic knob and erosion of the ribs, which were seen in 100 per cent of the 13 cases.—*James J. McCort.*

GREENEBAUM, J. V., and HARPER, F. G. Right-sided transient paralysis of the diaphragm in a newborn infant. *J. Pediat.*, April, 1946, *28*, 483–487.

The authors report the eighth case of paralysis of the diaphragm due to isolated phrenic nerve injury. Twenty-five cases of paralysis of the diaphragm associated with brachial paralysis in the newborn have been reported. Kafferath was the first to study these cases fluoroscopically and he described the paradoxical movements of the paralyzed diaphragm essential to the diagnosis.

The authors' case was delivered without undue difficulty by low forceps. Resuscitation was difficult. On the fourth day it was noted that the baby had difficulty with breathing and did not nurse well. Fluoroscopic examination on the seventh day of life showed paradoxical movement of the right diaphragm. Treatment consisted in placing the child on the right side, administration of oxygen and feeding by gavage. Improvement was immediate and steady. The baby was discharged on the twenty-sixth day in good condition. Subsequent fluoroscopic examination showed normal movement of the right side of the diaphragm with no mediastinal shift.

The authors conclude that injury to the phrenic nerve in the newborn is probably more common than is realized in view of its intimate relation to the brachial plexus. It should be more often suspected and its presence or absence confirmed by fluoroscopic check of the movements of the diaphragm.—*R. M. Harvey.*

BAKWIN, HARRY, GALENSON, ELEANOR, and LEVINE, BERNARD E. Roentgenographic appearance of the esophagus in normal infants. *Am. J. Dis. Child.*, Oct., 1944, *68*, 243–247.

Roentgen studies of the esophagus by means of an opaque meal were made on 32 normal infants ranging in age from three weeks to twenty-two months. In their summary the authors state the esophagus in the infant is a distensible tube and may be as wide or wider than the vertebral column. The wide shadow cast by it may readily lead to an erroneous diagnosis of cardiospasm. The presence of food in the esophagus for some time after a feeding has been completed may be falsely interpreted as due to retention, especially if the subdiaphragmatic portion of the esophagus is visualized as a narrow thread-like channel. Pooling of material in the lower portion for a considerable length of time after feeding is common and is ordinarily due to reflux from the stomach.

In general, the contours were uniformly smooth. Usually, the esophagus was sinuously curved, with the convexity to the left above and to the right below, but this was not always the case. In some instances it was curved as though it were too long for the thorax.—*R. S. Bromer.*

VINSON, P. P. Cardiospasm in the newborn. *J. Pediat.*, Dec., 1945, *27*, 565–566.

Vinson feels that the term cardiospasm should be reserved for cases with persistent dysphagia and with roentgenoscopic evidence of obstruction at the cardiac end of the esophagus without evidence of organic stenosis. For all other cases with intermittent symptomatic delay in swallowing he prefers the term spasm of the esophagus or cardia. He does not feel that the cases of so-called cardiospasm described occasionally in the newborn and in whom symptomatic relief occurs following catheterization of the esophagus are true cases but are due to temporary incoordination of the neuromuscular mechanism of swallowing.

In support of his contention he cites the case of a seven day old infant who had regurgitated food since birth and had fluoroscopic evidence of obstruction to the barium stream at the cardia with dilatation of the esophagus above the obstruction. The case was treated by administration of concentrated oral food and subcutaneous fluid with complete recovery.—*R. M. Harvey.*

ABDOMEN

HRDLICKA, VICTOR E., WATKINS, CARLTON G., and ROBB, JOHN A. Cholecystography for children. *Am. J. Dis. Child.*, Nov.–Dec., 1945, *70*, 325–328.

The results of cholecystography with priodax

for 47 unselected infants and children are reported in this paper. The technique used is summarized as follows: (1) The regular evening meal is given but it contains no fat. (2) Priodax suspended in fruit juice is given about two hours after the evening meal. (3) No breakfast is given, but water is allowed. (4) Roentgenograms are taken at twelve, fourteen and sixteen hours. If the gallbladder is not visualized, the same procedure should be repeated again that evening. The ordinary dose of 0.5 gm. per 10 kg. of body weight is adequate for children over four years, but larger dosage, even 1.5 gm. per 10 kg., may be necessary for younger children and infants.

In the group under six months of age there were six attempted visualizations with none successful. In the group six to twelve months old, there were 4 patients, 1 having good, 1 very good and 2 no visualization. Four patients were examined in the group twelve to eighteen months old, in 1 of whom the gallbladder was visualized only fairly well; 2 others, both of whom were given only ordinary doses (0.5 gm. per 10 kg.), had good shadows. In the group for children two to four years old, of 5 patients, 2 had good and 1, excellent gallbladder shadows.

Toxic effects were minimal, even in very young infants given two or three times the ordinary dosage.—*R. S. Bromer.*

Rosenberg, A. A., and Heath, M. H. Acute gastric ulcer with perforation in one of premature twins. *J. Pediat.*, Jan., 1946, *28*, 93–95.

Bird, Limper and Myer collected 243 cases of peptic ulcer in infants and children from the literature. Of these only 51 were in the age group from fifteen days to one year and of these only 8 were gastric ulcers. The authors report a case occurring in one of homologous twins. The twins had parallel post-natal courses until the ninth day when one developed vomiting, weight loss, refusal of feedings and progressive weakness. On the thirty-sixth day the vomitus became brownish, later projectile and finally the stools became brownish. A roentgenogram on the fourty-seventh day showed a large gas-filled stomach with three-hour barium retention. The roentgen diagnosis was pyloric stenosis. It is not stated whether fluoroscopy was performed.

Autopsy revealed a perforated gastric ulcer on the lesser curvature, 1 cm. from the pylorus. Surgery had not been attempted because of the size of the infant.—*R. M. Harvey.*

Learner, Norman, Stauffer, Herbert M., and Brown, Charles L. Small intestinal disorders in avitaminosis. *Ann. Int. Med.*, April, 1944, *20*, 675–685.

The authors review the literature on the changes found in the small intestine resulting from vitamin deficiency, mainly those of the B complex. Two cases are presented to illustrate the roentgenologic changes of deficiency states.

The authors state that there are limitations to the dependability of the "deficiency pattern" as a criterion for the diagnosis of vitamin B complex deficiency. If the roentgenographic changes are mild they cannot be distinguished from normal variations since no extended series of complete small intestinal studies in normal individuals has been published. In addition, it is possible that modifications in the pattern of the same patient may occur from time to time depending on other factors, for example, emotional disturbances.—*James J. McCort.*

Grimson, K. S., Vandergrift, H. N., and Dratz, H. M. Management and prognosis of megacolon (Hirschsprung's disease). *Am. J. Dis. Child.*, Aug., 1944, *68*, 102–115.

This paper consists of a very complete report of 24 patients with megacolon. In all, the diagnosis was thoroughly established. The cases were divided into three groups. The first included 12 patients with uniform and occasionally immense enlargement of the entire colon with definitely and at times also immense enlargement of the rectum. The second group included 7 patients with uniform and usually immense enlargement of the entire proximal portion of the colon ending distally, usually in the sigmoid region, with a normal segment of colon and a normal rectum. The third group included 5 patients with enormous enlargement of the sigmoid flexure and the descending colon, with or without some degree of involvement of the proximal portion of the colon and rectum. This condition is classically separate from the others and has been described in the literature as achalasia.

The authors conclude from their study of the series that protracted medical management of patients in the first group is indicated as long as adequate nutrition can be maintained and persistent abdominal distention avoided. Sympathectomy does not alter significantly the gross pathologic conditions, and by interrupting visceral sensory pathways it may permit negli-

gence on the part of the patient and the development of serious impactions. Segmental resection of the colon, as reported in the literature, has been followed frequently by impactions proximal to the anastomosis. They therefore suggest that resection of the colon, if indicated for a patient in this group, should start at the cecum and continue distally through the proximal divisions of the colon to the sigmoid region if necessary in order that liquid contents of the ileum may empty into the remaining, and preferably, rather short, segment of involved bowel.

Patients in the second group demonstrated greater or more persistent abdominal enlargement than was observed in the other patients. For this group, the authors state that when medical management fails to control obstipation and distention and symptoms become alarming, colostomy or, if possible, resection of the megacolon is indicated.

For the third group it would seem that protracted medical management of patients is justified and that in patients with normal segments of lower sigmoid colon and normal rectums the structures may become progressively dilated and accomplish massive evacuations of impactions.

The prognosis and choice between protracted medical management and resection of the colon may be facilitated by careful examination of the distal portion of the colon by repeated rectal and proctoscopic examinations, and by roentgen examinations after enemas of barium and air; and of the proximal segments of the colon by roentgenography after oral administration of barium sulfate. The examinations must be repeated after decompression of the colon, because normal rectums and normal segments of sigmoid colon may appear enlarged during the delivery of an impaction.—*R. S. Bromer.*

GYNECOLOGY AND OBSTETRICS

Rubin, I. C., Novak, J., and Squire, J. J. Ovarian fibromas and theca-cell tumors: report of 78 cases with special reference to production of ascites and hydrothorax (Meigs' syndrome). *Am. J. Obst. & Gynec.*, Nov., 1944, *48*, 601–616.

The association of abdominal ascites with hydrothorax was observed as far back as 1879 when Cullingworth reported a case. Its clinical importance and practical implications, however, were not appreciated until Meigs and Cass called special attention to the syndrome since become known as Meigs' syndrome.

In the period between 1928 and 1943, 78 cases of fibromas and theca-cell tumors were encountered in the Mount Sinai Hospital. Theca-cell tumors were included in the statistics because (1) they typify Meigs' syndrome as well as the fibromas; and (2) because in the period between 1928 and 1936, no distinction was made in the pathologic reports between these two kinds of tumors. Since 1936, every ovarian tumor of connective tissue variety was stained for fat, and the fat content has been regarded as an important characteristic of theca-cell tumors in differentiating them from fibromas.

Clinical Significance of Ascites in Relation to Ovarian Tumors in General.

1. Ascites, which is commonly found in the presence of ovarian tumors, as a rule indicates the spread of malignancy to the peritoneum.

2. Pseudomyxoma and papilloma of the ovary produce peritoneal implantation, and though histopathologically not malignant, they assume an intermediate position between benign and malignant tumors, and produce in each case a similar type of ascites.

3. Torsion of the pedicle, necrosis and inflammation may produce ascites in benign as well as malignant tumors. The amount of effusion in these cases is usually scant.

4. Dermoid cyst and pseudomucinous cysts are only exceptionally accompanied by ascites, and the more recently described Brenner tumors are never associated with ascites.

Origin of Ascites. The problem of the origin of the ascitic fluid is still unsolved.

Origin of Hydrothorax. Even more challenging than the origin of ascites in ovarian fibromas was the explanation as to why the ascites was in some cases accompanied by a right-sided, and more rarely by a left-sided or bilateral pleural effusion. In a study of this problem, the following considerations appear to the authors to be basic.

(1) The pleural effusion disappears a few days after the removal of the ovarian tumor. Therefore, it is a direct result of the tumor.

(2) The pleural effusion has the same properties as the ascitic fluid.

(3) The effusions have the characteristics of transudates and not of exudates.

(4) The anatomic route by which fluid can be transferred from the abdomen into the

pleura was identified a long time ago. Each half of the diaphragm forms a separated lymph sphere which has only scant connections with the other side. The right lymph network is by far better developed than the left. Both subperitoneal lymph networks communicate with the corresponding subpleural lymph networks through perforating vessels. In its transference from the subperitoneal to the subpleural lymph vessels the ascitic fluid follows the normal current directed toward the heart. The intensity and velocity of this flow depends mainly on the respiratory action of the diaphragm which not only exerts a pump effect on fluid situated on the surface of the liver, but also considerably influences the width of the diaphragmatic stomata.—*Mary Frances Vastine.*

Blackwell, William J., Dockerty, Malcolm B., Masson, James C., and Mussey, Robert D. Dermoid cysts of the ovary; their clinical and pathologic significance. *Am. J. Obst. & Gynec.*, Feb., 1946, *51*, 151–172.

To many the term "ovarian dermoid" cyst denotes merely a ball of hair invested by a mantle of ectodermal tissue occasionally supporting one or more teeth. Careful examination, however, frequently reveals a variety of tissues including bone, cartilage, smooth muscle, fat, and so forth, all of which make rather indefinite the dividing line between this type of tumor and members of the more complex teratoma group. Although many papers have been published on ovarian dermoids, these contributions to the medical literature have, for the most part, been based on a study of a single case or a small series of cases. With the feeling that a review of a large group of these tumors might produce some valuable information, the present study was undertaken with the following questions in mind: namely, what are the usual histologic components of the tumors and how many tumors are truly monodermal? Are the symptoms and signs produced diagnostic of the tumor type? What is the incidence and what are the types of malignant transformation seen in ovarian dermoids?

Studies of the data obtained from the records of 225 patients who had cystic teratomas removed surgically at the Mayo Clinic and from the microscopic examination of 100 consecutive tumors permits of drawing the following conclusions:

1. Ectodermal derivatives were present in 100 per cent of the tumors, mesodermal structures in 93 per cent, and entodermal derivatives in 71 per cent of these cysts.

2. The high percentage of mesodermal and entodermal elements was due to the fact that multiple sections have been examined microscopically. Serial sections would probably have revealed more.

3. The term "dermoid" is inaccurate and should be replaced by the term "cystic teratoma."

4. The hypotheses that have been advanced to explain the histogenesis of these neoplasms do not explain their origin adequately.

5. These tumors occurred with equal frequency in either ovary.

6. Twelve and four-tenths per cent were bilateral.

7. The average diameter was 8.2 cm.

8. The incidence of cystic teratomas was 5 per cent of all ovarian neoplasms.

9. Malignant lesions occurred in 3 per cent of cystic teratomas.

10. Symptoms associated with these cysts had no differential diagnostic value.

11. Surgical removal was the treatment of choice, but, when possible, resection of the tumor was done to conserve ovarian function.—*Mary Frances Vastine.*

Burket, Joseph A., and Abell, Irvin. Primary masculinizing tumors of the ovary. *Surg., Gynec. & Obst.*, Dec., 1944, *79*, 651–654.

Several of the best examples of physiologically functioning neoplastic tissue are the feminizing and masculinizing tumors of the ovary. The most common one is the granulosa cell tumor which secretes estrone, resulting in precocious sexual development in young girls, or a return of menstruation in women past the menopause.

There are two masculinizing tumors of the ovary: the arrhenoblastoma and the adrenal cell tumor of the ovary between which it is almost impossible to make a clinical distinction.

Symptomatology.

1. Defeminization. There is usually first of all a persistent amenorrhea with sterility and then an atrophy of the breasts. The external genitalia are usually normal. There may be an abnormal change in the deposit of fat so that there is a loss of the rounded contour characteristic of the female. The heterosexual libido usually remains unchanged.

2. Masculinization. Hirsutism usually ap-

pears rather early and the beard may become quite heavy. There is masculine distribution of the pubic hair and a recession of the hair line of the head. The skin becomes dark and rough and acne is quite common. There is a lengthening of the vocal cords resulting in a voice of lower register. After several years, the clitoris is usually hypertrophied.

It is practically impossible to differentiate the adrenal cell tumor from the arrhenoblastoma. However, masculinization resulting from the arrhenoblastoma is essentially the same as that resulting from excess administration of testosterone. In fact, the changes are thought to be due to the production of testosterone or a similar hormone by the Leydig cells which constitute part of this tumor. On the other hand, when the masculinizing changes result from adrenal cortical hyperplasia or adrenal rest tumors of the ovary, there are definite metabolic disturbances resulting in the so-called Cushing syndrome. In these cases one usually finds an associated hypertension, polycythemia and diabetes. The hypertension may be due to overproduction of some compound similar to desoxycorticosterone; the diabetes may be caused by the adrenal diabetogenic hormone; there is no suggestive cause of the polycythemia. If the masculinization results from an adrenal tumor there will be a decrease in the serum sodium and an increase in serum potassium, while the urinary sodium is increased to three times the normal and the potassium is decreased. Also, if the virilism results from adrenal cells, the nitrogenous retention may be five or six times the normal. The sex hormone secreted by the adrenal cells produces sex characteristics of the opposite sex, so that a woman develops amenorrhea, breast atrophy, enlarged clitoris, and hirsutism, while the male has breast hypertrophy, testicular atrophy, female distribution of adipose tissue, and loss of libido.

Cushing's disease or basophilic adenoma of the anterior pituitary gland must be differentiated from the other masculinizing tumors.

Histogenesis. Myer and Novak believe that the arrhenoblastomas arise from embryonic remnants of the seminiferous tubules in the hilus of the ovary. The adrenal cell tumor probably arises from an adrenal cell rest in the ovary

Pathology

Arrhenoblastoma. These tumors are unilateral and usually solid although some may be cystic. The one gross distinguishing feature is the presence of multicentric nodules. The microscopic picture varies considerably with the distribution of the epithelial cells: (1) tubular, (2) cylindroid, (3) diffuse or sarcomatoid. There are pale staining interstitial cells and the degree of masculinization is dependent upon the presence of such elements. Microscopically, the malignancy of these tumors is shown by the presence of multiple mitotic figures, variation in size and staining of cells, and large nucleoli.

2. Adrenal cell tumor of the ovary. These tumors are also unilateral. All are solid. A characteristic gross feature is the golden-yellow color. These tumors are usually encapsulated by thinned out ovarian cortex. Microscopically, the cellular picture is almost identical with that noted in the ordinary hypernephroma: large granular polyhedral cells lie in a mosaic arrangement mainly around numerous, fine capillary vessels. The large polyhedral cells contain, as a rule, lipoid material.

Treatment. Surgery is the treatment of choice. After removal of the tumor there is usually a return of menstruation within a month. The breasts resume normal size in a comparatively short time. The disappearance of masculinization is much slower, the hirsutism remaining for a very long time. If there is recurrence of the tumor, there is again defeminization.

It must be emphasized that these tumors are malignant, or at least potentially so, the growth being continuous and progressive, with death resulting from malignant metastases. It is recommended that roentgen therapy be given if there are evidences of metastasis or recurrence.—*Mary Frances Vastine.*

Saphir, Otto, and Lackner, Julius E. Adenocarcinoma with clear cells (hypernephroid) of the ovary. *Surg., Gynec., & Obst.*, Nov., 1944, *79*, 539–543.

Two yellow, obviously malignant tumors of the ovary are reported, which in no way are related to those producing masculinization. These tumors were identical with carcinomas occurring in the kidneys. Such tumors, when encountered in the kidney, are designated either adenocarcinoma with clear cells or hypernephroid carcinoma (resembling suprarenal cortical structures). The same nomenclature should be applied to the identical tumors described here in the ovary.

From this investigation and from the literature it seems that two types of yellow ovarian tumors must be distinguished, each presenting

a different histopathological picture. One causes masculinization and is either a luteinized granulosa cell tumor and may be called lutein cell tumor, luteinoma, etc., or, if it arises from suprarenal cortical structures, it is called hypernephroma. The other tumor does not produce endocrine disturbances and arises apparently from mesonephric structures within the ovary. This is the hypernephroid carcinoma or clear cell adenocarcinoma.—*Mary Frances Vastine.*

Fahlund, George T. R., and Broders, Albert C. Postmenopausal endometrium and its relation to adenocarcinoma of the corpus uteri; study of 236 cases. *Am. J. Obst. & Gynec.*, Jan., 1946, *51*, 22–38.

Summary and Conclusions

1. The material studied consisted of postmenopausal uteri in 236 cases. In 86 of these cases the uterus had been removed because of adenocarcinoma, and in 100 cases it had been removed for other reasons. In 50 cases routine necropsy had been performed.

2. In the group of 86 women who had adenocarcinoma of the corpus uteri, all but one had had vaginal bleeding or spotting as a presenting complaint.

3. In the 86 cases of adenocarcinomatous uteri there was no appreciable variation in the percentage of cases with proliferative endometrium, whether early or late, or in the percentage of cases with atrophic endometrium, according to the grade of malignancy.

4. There was no appreciable difference in the percentage of cases of any given type of endometrium in adenocarcinomatous uteri as compared with non-adenocarcinomatous uteri, except with regard to atrophic endometrium. Thus, 41.8 per cent of cases of uteri with malignancy showed atrophic endometrium and only 16 per cent of cases of uteri without malignancy showed atrophic endometrium. This suggests that adenocarcinoma of the uterine corpus is more likely to occur in cases in which there is atrophy of the endometrium than in cases in which there is no atrophy.

5. Two of the 86 cases of adenocarcinomatous uteri and 3 of the 150 cases of non-adenocarcinomatous uteri presented some features similar to those found in early differentiative endometrium but since they were not entirely the same the endometrium was classified as late proliferative.

6. The percentage of cases with grade 3 and 4 cystic change and with grade 3 and 4 accumulation of secretion was roughly the same in the two groups of cases. Approximately 42 per cent of adenocarcinomatous uteri showed no cystic changes, whereas 20 per cent of non-adenocarcinomatous uteri showed no cystic changes. This lends evidence contrary to the view that the "Swiss-cheese endometrium" of Novak has any features predisposing to the development of carcinoma.

7. There was no consistent difference or variation of cystic change, accumulation of secretion in the glands, density of the stroma in and beneath the endometrial epithelium, involvement of the subbasal glands or sclerosis of the arteries and arterioles, according to the grade of adenocarcinoma. In 28 of the 86 cases no subbasal glands were found. Thus, subbasal glands seem to have no causal relationship to adenocarcinoma of the uterus.

8. There was virtually no difference in average thickness of endometrium in adenocarcinomatous uteri as compared with non-adenocarcinomatous uteri.

9. The incidence of endometrial polypi in uteri without adenocarcinoma was roughly eight times greater than their incidence in uteri containing adenocarcinoma. However, previous curettage in all cases of malignancy might be partially responsible for the variation.

10. In general, it may be concluded from this comparison of adenocarcinomatous and non-adenocarcinomatous uteri removed from women who had passed the menopause, that the uninvolved portion of endometrium in the former group was in no demonstrable way different from that of the endometrium in the latter group except that *atrophic endometrium was found more often in adenocarcinomatous uteri than in non-adenocarcinomatous uteri, while endometrial polypi were found more often in non-adenocarcinomatous uteri.*—*Mary Frances Vastine.*

McLane, Charles M. The isometric method of x-ray pelvimetry as a routine procedure. *Am. J. Obst. & Gynec.*, Nov., 1945, *50*, 495–502.

The isometric method of roentgen pelvimetry has been presented by the author as an accurate, comprehensive, and relatively inexpensive way of measuring the female pelvis and of studying all its morphologic characteristics.

Technique

1. An anteroposterior film is taken in which the patient lies on the table with the shoulders

resting on three pillows placed lengthwise and with a rolled sheet 4 inches thick placed under the lumbosacral curature. In this view the tube-film distance is 25 inches.

2. A lateral film is taken with the patient lying in the same position and in which the roentgen-ray beam is directed horizontally. A notched metal centimeter scale is placed in front of the symphysis pubis in a vertical position. The tube-film distance is 36 inches in this view.

3. The following points are noted on the lateral film:

a. The upper inner and lower border of the symphysis.

b. The point at which the iliopectineal line crosses the sacrum.

c. The inner tip of the fifth sacral vertebra.

d. The ischial spines.

e. The mid-point on a line joining the ischial tuberosities.

4. The following lines are drawn on the lateral film:

a. One connecting the upper and inner border of the symphysis and the point where the ileopectineal lines cross the sacrum. (This line represents the obstetric conjugate.)

b. A line at right angles to the obstetric conjugate passing through the base of the ischial spines. (This divides the pelvis into an anterior and posterior segment.)

c. A base line across the film, representing the top of the roentgen-ray table on which the metal rule rested.

5. The following measurements are made on the lateral film:

a. The obstetric conjugate.

b. The posterior and anterior sagittal of the inlet.

c. The posterior sagittal of the mid-pelvis and outlet and the anteroposterior diameter of the outlet.

d. Three heights are recorded: *TR* which represents the distance of the transverse diameter of the inlet from the base line of the roentgen-ray table, *SP* which is the height of the ischial spines from the table, and *TI* the height of the line joining the tuberosities of the ischium from the base line.

6. The following points are marked and connected by a line on the anteroposterior film:

a. The greatest transverse diameter of the inlet.

b. The ischial spines

c. The points for measuring the tuberosities of the ischium.

Calipers are placed on the two points marking the transverse diameter of the inlet and then placed on the scale in the distorted centimeter scale that corresponds to the height *TR* in the lateral film. In a similar manner the interspinous and intertuberous measurements are made, using the scale that corresponds to their heights as determined from the lateral film.—*Mary Frances Vastine.*

Corscaden, James A., Fertig, John W., and Gusberg, S. B. Carcinoma subsequent to the radiotherapeutic menopause. *Am. J. Obst. & Gynec.*, Jan., 1946, *51*, 1–12.

In the routine follow-up examination of about 1,100 patients in whom an artificial menopause had been induced because of benign uterine bleeding, fibromyoma, or one of a few other benign conditions, there were noted 36 cancers in various parts of the body, 15 of which were of the uterus (9 in the corpus and 6 in the cervix). Thorough statistical analysis of the data showed that there was a slight excess of cancer other than uterine and a statistically significant excess of cancer of the uterus, particularly of the corpus, over the number that might be expected to occur among an equivalent group of the general population followed for the same length of time.

Conclusions. Among 958 patients treated for benign uterine bleeding by the radiotherapeutic menopause and followed for 6.7 years each, on the average, there subsequently occurred 15 carcinomas of the uterus. Based on modified mortality statistics, the same number of women in the general population during the same length of time should contract 4.4 carcinomas of the uterus. The observed number of cases is therefore 3.4 times as large as the number expected.

Two and eight-tenths per cent of women in the general population between the ages of thirty and fifty-five years contract cancer of the uterus before reaching the age of eighty. Applying the above ratio of 3.4 we find that 9.6 per cent of women suffering from uterine bleeding prior to the menopause would contract the disease.

Of 15 cases, 9 were of the corpus and 6 of the cervix. This abnormal preponderance of carcinoma of the corpus is in agreement with that present in other reported cases in which the

ratio is 2 of corpus to 1 of cervix. This ratio of corpus to cervix is six times that obtaining in this clinic.

It is inferred that the endometria of uteri which bleed abnormally prior to the menopause are predisposed to the subsequent development of carcinoma of the corpus.

Prophylaxis against carcinoma of the uterus should be an important factor in a plan of treatment for uterine bleeding prior to the menopause.—*Mary Frances Vastine.*

Jones, G. E., and Te Linde, R. W. The curability of granulosa-cell tumors. *Am. J. Obst. & Gynec.*, Dec., 1945, *50*, 691–700.

The authors report in detail 3 cases of granulosa cell tumors in which recurrences developed not less than fourteen years after the original operation. Their conclusions are:

1. All 3 patients have died, eighteen, twenty and twenty-one years, respectively, following the removal of the primary tumor in spite of the fact that the tumors were well encapsulated and showed no evidence of metastasis or implantation at the original operation. One case recurred in spite of bilateral salpingo-oophorectomy.

2. One case with widespread inoperable abdominal metastases, responded well to deep roentgen therapy over a period of three years but a subsequent recurrence of the growth proved refractory to treatment.

3. Total urinary estrogen values were not extremely high in 2 cases but within the range of values for normal cyclic women. However, the values were well above those usually found in this laboratory for postmenopausal women, into which age group all 3 patients fell at the time of recurrence. All 3 cases exhibited clinical signs of estrogenic activity on recurrence of the tumor.—*Mary Frances Vastine.*

GENITOURINARY SYSTEM

Lich, R. Jr., and Lewis, P. J. The use of the antidiuretic property of pitressin in excretory pyelography. *J. Urol.*, Oct., 1945, *54*, 400–402.

Experimental evidence has proved that the pressor principle of the posterior pituitary extract has an antidiuretic effect. In 1930 Leberman suggested that this fact be made use of in concentration renal function tests. Schneeberg, Likoff and Rubin have recently shown that the subcutaneous administration of 10 cc. of surgical pituitrin will cause the excretion of urine in normal humans with a specific gravity equivalent to that produced by an eight to ten hour period of water deprivation. This fact led the authors to substitute the administration of pitressin for water deprivation. They found that pitressin had a greater antidiuretic effect when the urine was of low specific gravity and this indicated that urograms might be more effective if pitressin administration were combined with hydration.

Their practice now is to do intravenous pyelography on any patient requiring such a study with the subcutaneous administration of pitressin, 0.5 cc., 15–20 minutes before the injection of the dye as the only preparation. They have been entirely satisfied with their results and found that all urograms so performed were interpretable in the absence of technical roentgenographic failures.

Pitressin is contraindicated in pregnancy. The authors have seen a few cases develop pallor, but they have had no serious complications and feel that those cases which formerly developed unfavorable side effects from pitressin for removal of abdominal gas were cases of starvation and water deprivation and that such effects should not be expected where normal hydration is maintained.—*R. M. Harvey.*

Lazarus, J. A., and Marks, M. S. Primary carcinoma of ureter with special reference to hydronephrosis. *J. Urol.*, 1945, *54*, 140–157.

The authors report the case of a forty-one year old woman who had one attack of dysuria at the age of twenty-eight and a second attack at the age of forty-one. Following the second attack physical examination revealed a mass the size of an orange in the epigastrium. This mass could be pushed forward by pressure over the left loin. Cystoscopy showed complete obstruction of the left ureter at 11 cm. A flat roentgenogram of the abdomen showed lateral dislocation of the lower pole of the left kidney and a "pear-shaped shadow" parallel to the left psoas muscle shadow. Excretory urography revealed no function of the left kidney. Operation disclosed a huge hydronephrotic left kidney secondary to a tumor of the left ureter which proved histologically to be a large transitional cell carcinoma. Following operation the patient was given a course of deep roentgen therapy.

The authors discuss ureteral tumors in general. They divide them into two main classes: those arising in the ureteral mucosa and those

arising from other parts of the ureteral wall. They subdivide the former into (*a*) papillomata; (*b*) papillary carcinomata, and (*c*) nonpapillary carcinomata. The latter group comprise 42 per cent of all malignant tumors of the ureter. The symptoms of ureteral carcinomata are hematuria, pain and occasionally tumor, the latter being not the carcinoma itself but the hydronephrotic kidney which results from obstruction.

Lazarus and Marks collected a total of 156 cases of primary carcinoma of the ureter from the literature and found that the correct diagnosis was not even suspected in over 50 per cent of the cases. A persistent defect in the ureterogram is the most significant diagnostic finding. The most frequent sites for metastasis are retroperitoneal lymph nodes (28.9 per cent), liver (14.9 per cent), bones (12.3 per cent) and lungs (7 per cent). The treatment of choice is complete extraperitoneal nephroureterectomy.—*R. M. Harvey.*

Sauer, H. R. Case of ureterocele with stone formation in ureter, ureterocele and bladder. *J. Urol.*, Aug., 1945, *54*, 158–161.

The author presents a case of a fifty-five year old white female who complained of frequency and dysuria of two years' duration. Gross hematuria had been present for one year at the time of her admission to the hospital. Pelvic examination revealed a stony hard, tender mass at the base of the bladder on the left. Cystoscopic examination revealed a mass, 4 cm. in size, projecting into the bladder from the left ureteral orifice. A plain roentgenogram of the abdomen showed a stone, 3.5 by 2.5 cm. in the left side of the bladder, surrounded by two smaller stones. A fourth stone was seen near the mouth of the left ureter. Intravenous urography indicated that the latter shadow was a stone in the left ureter which showed dilatation above. There was a double kidney and ureter on the left.

The presence of stones in ureteroceles is not unusual but the extension of the stone formation into the ureter was unusual. There were also extensive calcareous deposits on the outer wall of the ureterocele which is another unusual complication. The upper urinary tract was free from secondary involvement.

The incrustations on the outer wall of the ureterocele were dissolved by continuous drip irrigation with solution G and the stones in the ureterocele and ureter were removed surgically following transurethral coagulation of the former.—*R. M. Harvey.*